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SYNCHRONOUS VS. INDUCTION MOTORS.

The descriptions in these columns* of the two largest induction motors in the world have excited some interest in the reason why the induction type was used in these large machines. A brief comparison of the relative merits of the two types may be of interest.

The induction motor is undoubtedly a more difficult and expensive machine to build for satisfactory duty than is the synchronous motor with fields excited by direct current. The field of the induction machine is necessarily excited by wattless alternating currents lagging behind the impressed electromotive-force waves, and the reduction of these lagging currents to a minimum is essential to good voltage regulation. This requires that the self-induction of both the primary and secondary of the motor be kept as low as possible, and that the air gap be also reduced. The low self-induction means a multiplication of the slots, which must be more numerous and consequently narrower than is necessary in synchronous machines of the same size, speed and frequency. This makes induction motors more difficult to wind and to insulate and absolutely prohibits their connection direct to high-voltage circuits, since the insulation required for many thousand volts would leave in these narrow slots no room for copper. Induction motors, therefore, must be supplied from high-voltage transmission lines through step-down transformers. This requirement does not apply to synchronous motors which are constructed now even in moderate sizes to take 10,000 volts direct. Extreme reduction of the air gap is also, of course, an added expense in the construction of the machine, as the parts must be accurately true and extremely rigid to run with a gap of one-sixteenth of an inch or less, as is now customary with rotors several feet in diameter.

The necessity of keeping down the magnetizing current in the induction motor increases its cost in another way, since it requires that a high magnetic induction shall not be used. The induction commonly used in synchronous motors is 100 per cent. or more greater than that used in good induction motors, and the output of the same amount of material is correspondingly increased. This advantage is partially, or often, wholly compensated by the fact that induction motors are worked usually at peripheral velocities higher than those used with any other type of electrical machines, running up often to 6000 or 7000 feet per minute, a practice perhaps justified by the simple, substantial and symmetrical character of the rotor when this is a "squirrel cage" secondary, although a synchronous motor with internal revolving fields is apparently capable mechanically of fully as high a speed. The main object of the high peripheral speed of the induction motor is, of course, to broaden the teeth and slots, with a fixed number of slots

*See THE ELECTRICAL WORLD, August 27, 1898, page 203, and September 10, 1898, page 258.

per pole and per phase. The comparatively high induction of the synchronous motor is permissible at all frequencies, owing to its better ventilating qualities, especially with unitooth structures, as compared with that of the induction motor, the ventilating ducts of which are seriously obstructed by the finely divided winding.

In the matter of starting, one type of the induction motor has a great advantage. With a wound secondary and an adjustable resistance in this circuit an induction motor can be started under any load with the same current that that torque would require at full speed. With short-circuited or "squirrel-cage" secondaries, a construction highly desirable owing to its simplicity and durability, induction motors (properly designed with low magnetic leakage) can be started light without excessive currents, and if thrown directly across the mains at standstill will develop a torque two or more times that of full-rated load, which is sufficient to overcome the standstill resistance of any style of commercial load; but unfortunately they take to do this four or five times their rated full load current, a considerable part of which is lagging. By means of voltage-reducing transformers the current drawn from the line and the torque can be reduced, the voltage reduction being limited by the torque required to start, since the torque is proportional to the square of the voltage. Synchronous motors, when constructed for self-starting on the induction principle—the field magnets being arranged to give a more or less effective closed-circuit secondary—have starting properties very similar to those of the induction motor with short-circuited secondary just mentioned, machines of the revolving field type having been constructed which could start, if thrown across the lines at standstill, against their rated-load torque with a current consumption about two and a half times that with the same load at synchronous speed.

The synchronous motor is, of course, out of the question for cranes, elevator and similar work, where a good torque per ampere is required over a great range of speeds. The induction motor with a variable resistance in the secondary behaves with such loads just as does a direct-current shunt-wound motor controlled with a resistance in the armature circuit. The most satisfactory machine for such loads from the standpoint of flexibility is the induction motor with a permanently high secondary resistance, the control being effected by a variation of the voltage, the action of such a motor being closely similar to that of a direct-current series motor on constant-potential circuits with rheostatic control (the speed varying somewhat in the inverse ratio with the load), the main differences being that the induction motor will not run away on no load, as will the direct-current machine, and that its efficiency is low at any and all speeds, owing to the high secondary resistance.

In the matter of overload capacity each type breaks down and stops when the load exceeds a certain limit. With induction motors this limit used to be from 50 to 100 per cent. higher than the rated load of the machine, but with modern types of low self-induction such motors will carry three, four or even more times their rated load without stopping. A good synchronous motor will carry so many times its rated load that it is impossible as a rule to test its capacity in this respect, the excessive heating destroying the motor before its breakdown limit can be determined. The synchronous motor has slightly better speed regulation than the other, as it maintains the same speed in cycles per second as the generator at all loads, while the induction motor with low-resistance secondary has a slight slip proportional to the load and amounting to about 5 per cent. in large machines at full load.

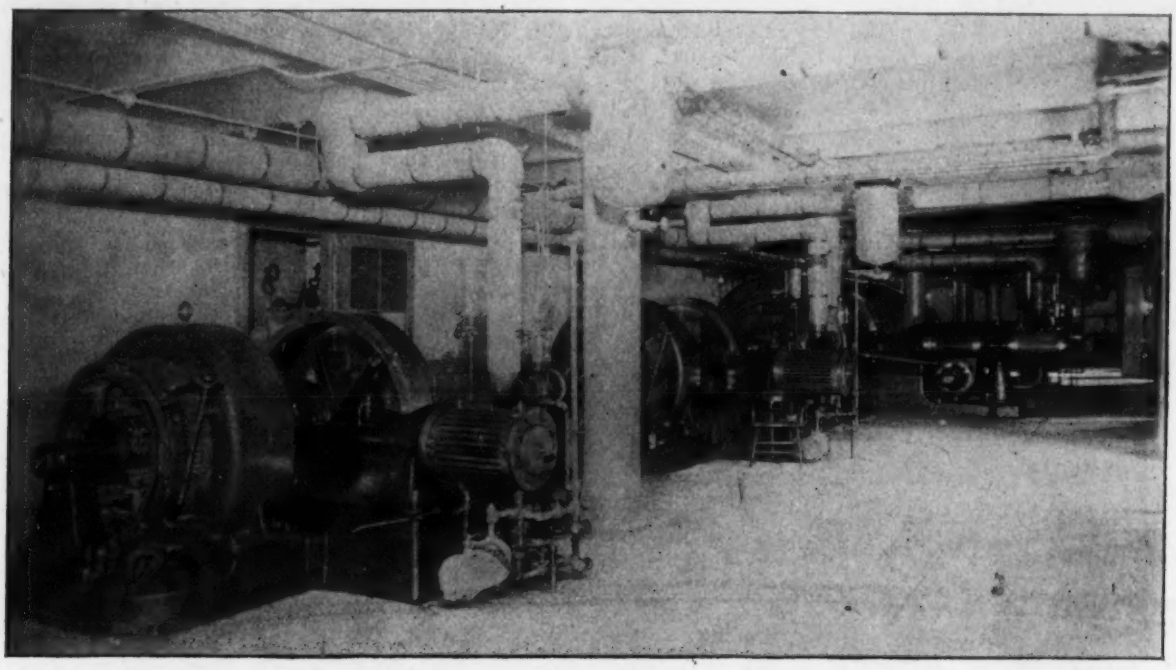
In many cases the greatest advantage of the synchronous motor is its ability to work without lagging or even cause leading currents in the apparatus and lines supplying it. The induction motor is the simpler of the two, requires less skilled attention and no exciter, but takes lagging currents which increase the drop in the generators, the lines and the transformers supplying it by a percentage far greater than the actual increase of the current consumption, owing to the reactive effects. The ordinary method of expressing the relative magnitude of wattless and energy currents —namely, by the power-factor percentage—is, by the way, a snare and a delusion. A power factor of 90 or 94 per cent., values often obtained with large induction motors at full load, gives the impression that the wattless currents are only from 6 to 10 per cent. of the total, whereas, on account of the vectorial relation, the wattless currents are in the one case one-third and in the other case one-half as great as the energy currents, giving in combination with the self-induction of generators, lines and transformers, corresponding reactive voltage drops. Synchronous excited machines, on the other hand, can, by powerful field excitation, be made to take wattless currents leading the impressed electromotive force, which not only do not increase the line drop, but act on the self-induction of the circuit to build up the voltage, and may, therefore, be made to neutralize the ohmic drop and even more than counterbalance it, making the voltage delivered at the receiving end greater than that generated. A synchronous machine, however, requires an exciter or some source of direct current to supply its field winding, and, to obtain good regulation of the line-drop by its means, requires intelligent attendance. Where a large number of small motors is distributed over one circuit the induction motor is undoubtedly the preferable type, owing to the simplicity of its construction and operation, but where the transmission of power is to one or a small number of large motors, and especially where the distance of transmission is great, the synchronous type is preferable, owing to its lower first cost, lower line drop and low cost of attendance per horse-power output. Where power is transmitted to many small motors and also over the same lines to one or a few comparatively large machines, the ideal solution is to make the small machines of the induction type and the large machine or machines synchronous, the latter being made to take sufficient leading currents to balance out the lagging currents of the former.

CHANGE IN INTERIOR CONDUIT WIRING.

By the recent ruling of the Underwriters a combination of lead-covered cable and iron-armored conduit is now no longer required in New York City work. Conductors must be braided and taped and may then be drawn into any iron pipe suitably protected against corrosion. This change will undoubtedly be followed in all work, as the construction now allowed is considerably lower, of course, in first cost, but it is doubtful if in the highest class of work the increased cost of the double protection may not be a good investment. The original provision of a lead covering was to avoid "sweating" or the deposition of moisture in the interior of the armor from soaking and thereby lowering the resistance of the insulating envelope, but this has been found a needless provision. An incidental advantage of no small value was obtained with the lead at a point where the conductors emerge from the conduit into the outlet boxes, where the lead sheathing could be carried through, preventing the sharp edges of conduit or box from coming in contact with the insulation and, in case of a sharp turn, cutting the latter. Some simpler method of avoiding this difficulty can, however, probably be found than the provision of a complete lead sheath.

The Heating and Lighting Equipment of the Grand Central Station.

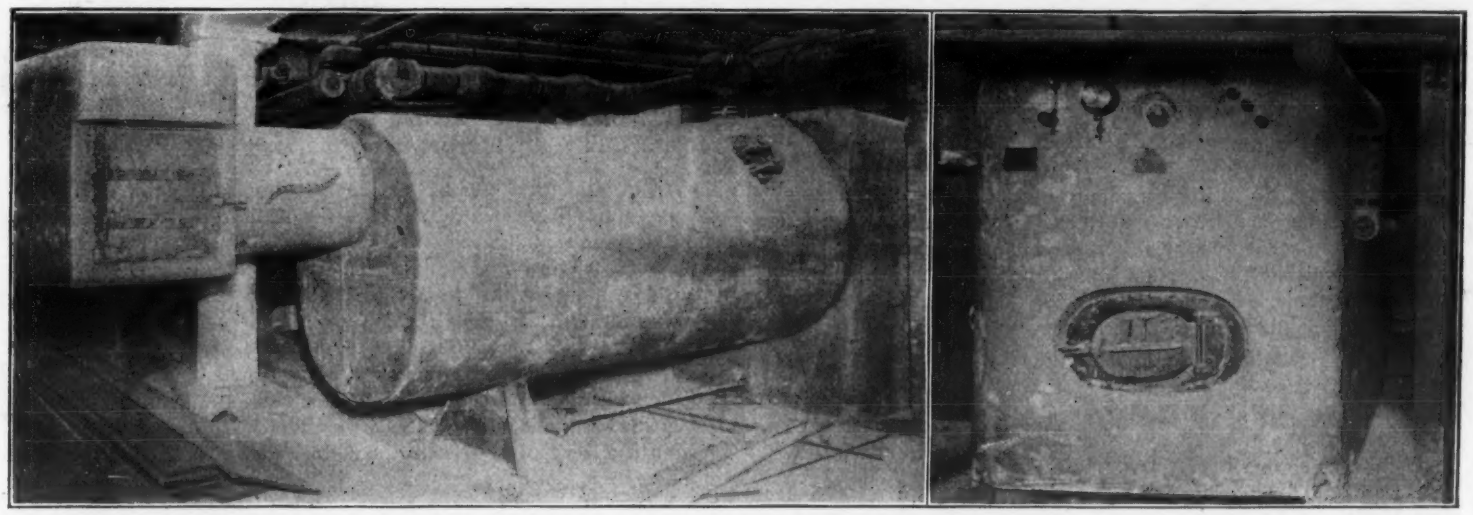
The Grand Central Station, New York City, the only railway station on Manhattan Island and the terminal of the New York Central & Hudson River and the New York, New Haven & Hartford Railroads, has recently been reconstructed in part to bring it up to modern requirements. The station was constructed some twenty-five years ago, and while commendable at that time is badly suited to the traffic now passing through it. The work of reconstruction so far undertaken applies only to the brick structure accommodating the offices of the railroad companies, the train sheds and waiting rooms, the other public parts of the station remaining as before. It has been generally understood that these were to be remodeled at the same time, but this is not the case. The new upper stories are carried on a steel framework, carried down through the old structure to new foundations.



A GENERAL VIEW OF THE ENGINE ROOM.

The steam-generating and steam-using elements are now consolidated under the Vanderbilt Avenue front of the structure, and in the sidewalk vault on that front. The boiler plant consists of six Belpaire locomotive-type boilers rated at 200 horse-power each. This unusual type of boilers for isolated plant work was chosen because of the lack of head room, which is only 9 feet at the place where the boilers were wanted, a heavy steel girder supporting the street wall of the building overhead clearing the tops of the boilers by a few inches at that height above the floor. In order to gain a little more head room the ash pits of the boilers are 16 inches below the floor level, and are separately drained to a sump pit from which water is lifted to the sewer by an automatic drainer. To prevent ashes getting into the pump the pit is divided by a partition or sill, on one side of which the ash pits drain, forming a settling tank, practically clear water passing over the sill into the other side, from which the pumps draw.

The feed pumps are placed in the boiler room, where the fireman can conveniently control their speed; they draw from a feedwater heater, in which the water level is automatically controlled by a float valve.



REAR AND FRONT VIEWS OF ONE OF THE BELPAIRE BOILERS.

The station and adjoining yards were previously illuminated by a small plant situated in a separate structure in the yards, consisting of an Ideal horizontal engine belted to two Edison bipolar dynamos; another small belted plant was added in another part of the yard as the demand for light grew, and the heating system of the station proper was situated at still a third point, the whole giving a very poor economy of fuel and attendance.

The flue gases pass from the boilers through sheet steel breeching to a steel stack 7 feet in diameter and 120 feet high, passing up through the train shed. The boiler and the breeching are covered with several layers of asbestos lagging made by the H. W.

Johns Company, the breeching in particular being provided with an intermediate air space covered with a wire screen and separate thickness of lagging to prevent overheating of the surrounding rooms.

The steam pressure is controlled in part by automatic damper regulators. The steam and water equipment of the building is most complete, many ingenious devices and auxiliary economies having been incorporated with the equipment by the consulting engineer, Mr. R. P. Bolton.

The exhaust steam is used for heating the building in winter, the whole heating plant being laid out on the Warren Webster system, by which back pressure is avoided by means of light suction applied to the drips by wet vacuum pumps. In case the pressure in the heating system rises above atmosphere an automatic valve, consisting of a Locke damper regulator with a 20-inch diaphragm, opens an atmospheric exhaust.

One of the little economies mentioned above is the use of a coil in the blow-off tank, through which all feed-water passes in summer before reaching the feed-water heater; this saves considerable of the heat ordinarily carried away with the blow-off to the sewer.

Another is the use of a condensing header on the top of the exhaust stack, this consisting of a large number of vertical tubes, through which the steam at atmospheric pressure passes, exposed externally to the action of the wind, which condenses a large amount of the exhaust steam, the drip from which is carried down into the feed-water heater. In this way considerable of the water and no small amount of heat is saved.

The pressure of the water supply of the building is maintained by air cushions in three water drums in the basement, which may be cross-connected to each other or separated on two systems of mains, one being the regular house supply and the other a fire main; thus there is always one tank for each of these mains, which may be run at the same or different pressures, and one standby.

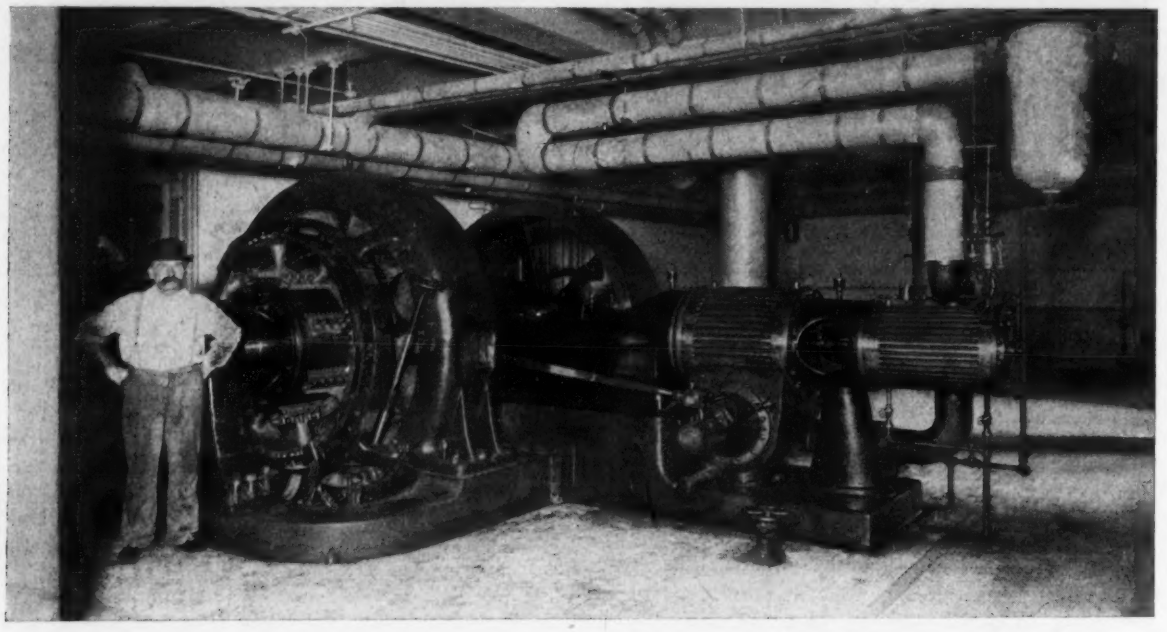
The electric lighting plant is supplied by a 10-inch main steam pipe over 300 feet long, and the means adopted for taking up the expansion of this header at the engine end are interesting; they consist simply of long, horizontal P-shaped bends in the engine branches, as shown in the accompanying illustration of the generating units. Close to the main stop valve of each engine is a steam separator with a trap, draining not only the separator but the nozzle just above the throttle. The four units consist of Ball & Wood horizontal high-speed engines direct-coupled to Crocker-Wheeler generators. Two of these are of 150-kw capacity each, the other two being respectively 75 and 50-kw capacity. The two larger engines are tandem compounds, the smaller being single-cylinder engines.

The switchboard of Tennessee marble is very simply arranged, being fitted with but one set of bus bars and the usual indicating instruments, but no main switches are used; in place of these H. Ward Leonard double-pole circuit breakers are used on all the machine circuits as well as the feeders, the independent action of the two poles rendering the use of switches in the same circuits unnecessary. The voltage is controlled by the American Electric Heating Corporation's button rheostats. The back of the board is lighted by a large window immediately in the rear.

The distribution system is one of the last installed under the underwriters' rules requiring both iron-armored circuits and lead-covered cables; it, therefore, has this double protection against injury, the pipes being dipped in enamel paint to prevent oxidation, the whole being laid out with great care. The outlet boxes are all steel, made by the Bossert Manufacturing Company, the lead sheath of the cable being terminated just inside the steel shell of the boxes; the panel boxes are fitted with beveled glass doors.

Practically no motors are in use in the building, the whole load consisting of the lighting of the offices, train sheds and the yards, inclosed arc lights being used, of course, for the latter points. The load is equivalent to 6000 incandescent lamps, and will, of course, be quite steady, owing to the large amount of space continuously illuminated all night.

The plant was installed under the supervision of the consulting engineer, Mr. Reginald Pelham Bolton, the railroad company being represented by its superintendent of motive power, Mr. W. M. Buchanan, the engineer in charge of the new as well as formerly of the old equipment being Mr. A. E. Pollard.



One of the 150-kw Generating Units.

Stoppages of Gas Supply.

We hear a good deal about the annoyances of failures of electricity supply from central stations, but little is said of the troubles and dangers incident to a failure of the supply gas. In Richmond, Va., a few nights ago, the breaking of a large gate valve in a gas main left the greater part of the city without gas shortly after midnight. Although the superintendent of the gas works soon discovered the cause of the trouble, he feared to turn on the gas again until the next morning, as it would have escaped from jets left burning and probably caused asphyxiations and explosions. A curious sequence of the failure was that the morning newspapers, which use linotype typesetting machines in which the metal is kept melted by a gas flame, appeared the next day with their pages set with such varieties of hand type as they could find at short notice, and most of the late news omitted.

The Production of Copper and Aluminum in the United States.

The official report of the mineral resources of the United States issued by the United States Geological Survey gives the production of copper for 1897 as 491,638,000 pounds, which is valued at $54,080,180, this being an increase of about 7½ per cent. over the previous year. Of aluminum the production is given as 4,000,000 pounds against 1,300,000 pounds for the previous year, the value for 1897 being estimated at $1,500,000.

The Regulation of the Mechanicville Plant.

The system of automatically regulating the voltage of power delivered to the works of the General Electric Company by the transmission line from Mechanicville is unusually elaborate and an interesting application of various principles of alternating-current working. This plant, which was described in THE ELECTRICAL WORLD of September 3, 1898, delivers power in two divisions to the General Electric Company, one for the testing department and the other for the running of the various motors driving the machinery of the shops. The former is supplied by a motor-generator set, consisting of a synchronous alternating-current motor wound for high-tension supply, coupled to a 500-volt multipolar railway-type generator. The speed of this unit is obviously dependent only upon and equal to the speed in alternations per minute of the generators at Mechanicville and the voltage of the direct-current end is thus obviously not affected by any changes of the voltage of the power delivered by the transmission line. The shop motors, however, are supplied through step-down stationary and rotary transformers, and as the voltage of the direct-current end of this sort of a transforming system is dependent on the alternating-current voltage delivered special means are necessary for properly adjusting the latter to obtain proper pressure on the distribution lines. The means adopted in this case are the use of leading and lagging currents by which the ohmic line drop can be inductively diminished or increased—a means previously used, notably in the St. Anthony Falls line—combined with an ingenious modification of a plan claimed in a patent issued to E. W. Rice, Jr., December 14, 1897.*

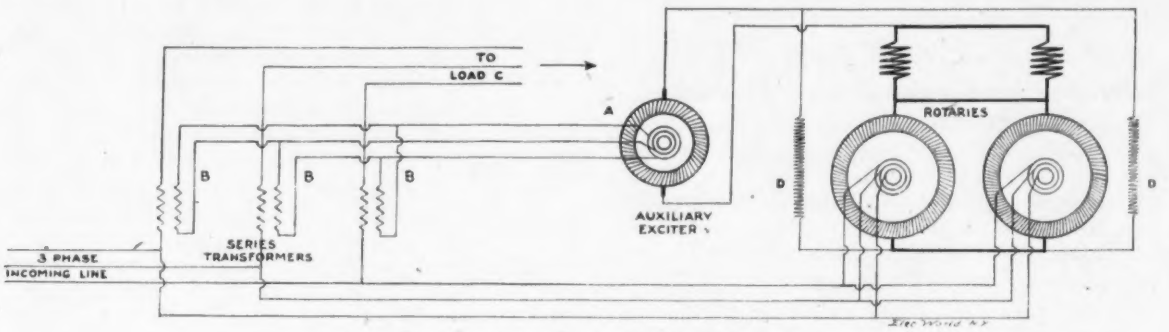
The system is practically compounded for constant potential at the direct-current terminals of the rotaries or it may be over-compounded at that point. The compounding is effected not internally in any machine, but strangely enough in the transmission line itself. The latter consists of three No. 000 wires all mounted on one cross arm. This naturally gives double the self-induction between the two outside wires as between either of them and the wire in the middle, but this effect is neutralized by the transpositions of the lines, another purpose of which is the reduction of inductive disturbances in neighboring telephone circuits. The rotaries at the receiving end of the system are compound wound with quite a heavy series winding, the ampere turns of the two field windings being so proportioned that on no load the excitation of the shunt winding is insufficient to generate at synchronous speed a back e. m. f. sufficient to choke back the impressed alternating-current waves.

The result is that wattless currents lagging behind the impressed e. m. f. enter the rotary armature and automatically increase the field excitation to a proper value. These lagging currents react upon the self-induction of the line, causing a drop considerably greater than that due to its resistance alone, and—the direct-current voltage being practically proportional to the impressed alternating voltage at the rotary rings—the reduction of the latter by means of the increased line drop prevents too great a pressure being delivered from the direct-current end on no load.

As the load rises, however, the action of the series fields of the rotaries begins to assert itself. As the direct-current excitation of the fields increases the wattless currents in the armature necessary to maintain the field excitation fall off until at a point about three-quarter-load the power factor of the incoming current approaches unity and the voltage drop on the line is equal only to the amperes multiplied by the line resistance. On further increasing the load the exciting action of the field windings of the rotaries becomes sufficient to generate a back e. m. f. at synchronous speed greater than that delivered and, as the rotaries cannot change their speed but must remain in synchronism with the generators at the other end of the line, the alternating currents, so to speak, automatically cut down the field excitation by a flow of wattless currents leading the impressed e. m. f. The action of this on the line inductance is the reverse of that of the lagging currents described above. In other words, the line drop is diminished and, in case the leading current and line inductance are of sufficient magnitude, the voltage-boosting effect in the line may even be greater than the ohmic or resistance drop, in which case the voltage at the receiving end is greater than that at the generating end. The direct-current pressure being proportional to the alternating-current pressure delivered, it is in turn compounded or even over-compounded if necessary. The direct-current pressure delivered by the rotaries is thus increased just as though they were engine-driven generators, by the use of a compound winding, but the effect is not immediately due to action of an increased field flux on the armature conductors, but is due to a boosting or depressing action of the inductances of the transmission circuit on the alternating currents therein.

In the case of the Mechanicville-Schenectady system, there is, of course, in addition to the self-induction of the line, the self-induction of the rotaries and stationary transformers and the generator armatures, at least for the present. If at any later time other transmission lines are run from Mechanicville to other cities it will become necessary to excite the generators for constant potential at the switchboard in order to prevent the various lines interfering with each other. In this case the self-induction of the generators cannot be depended upon, but at present the generator fields can be left at constant excitation and the voltage at Schenectady controlled entirely automatically by the compound fields of the rotaries, the self-induction of the generators materially aiding the inductive compounding.

This arrangement alone would be sufficient to obtain proper voltage regulation but for the interference of the load taken by the synchronous motors driving the generators of the testing department. Any increase of the load in this department increases the current in the line, consequently increases the ohmic or resistance drop without the proper compensating effect in the wattless currents taken by the rotary. Any variation also of the phase relations of the synchronous motor load will still further disturb the proper combination of the ohmic and inductive drop on the line, the sum of which two quantities should be, by the action of the rotaries described above, rendered a constant independent of the load. To make the rotaries take leading or lagging currents which shall balance out the disturbing effects of the synchronous machines the following system has been devised, this being as mentioned above a modification of Mr. Rice's recent patent. The rotary shunt fields, as shown at *D D* in the accompanying diagrammatic illustration, are excited from a separate direct-current bus bar which is fed with current from the main bus through an auxiliary exciter *A*. This auxiliary exciter serves to raise the voltage across the rotary fields and is driven by an alternating-current synchronous motor of the same number of poles, thus keeping its armature in step with the alternating system. It has no field exciting winding, but



DIAGRAMMATIC PLAN OF CONNECTIONS.

*See THE ELECTRICAL WORLD, February 12, 1898, page 219.

its armature is fitted with three collecting rings into which alternating current may be introduced from the secondaries of three small series transformers shown at *B*, the primaries of which are inserted in the lines feeding the synchronous motor *C*, and any other loads supplied over the same transmission line, with the exception of the rotaries. The armature of the auxiliary exciter is coupled to the synchronous motor at such an angle that the currents introduced from these series transformers, when the load passing through their primaries is of unity power factor, tend to set up a field of force in the magnetic circuit of the auxiliary exciter and build up a direct-current voltage across the brushes thereof; thus the greater the load on the system, *C*, the greater is the boosting action of the machine, *A*, and the greater in consequence the voltage across the field windings, *D*, of the rotaries. Further, if the load on the system, *C*, becomes lagging, tending thereby to still further increase the drop on the transmission line, the currents entering the armature of machine *A* lag also and excite to a correspondingly greater extent the field magnetic circuit of that machine, causing a greater current in the winding, *D*, of the rotaries, which in turn causes the armatures of the rotaries to take a leading current to cut down their excitation, this leading current balancing the lagging current of the load, *C*, and preventing any deleterious effect on the line drop. Vice versa, leading currents of the load, *C*, build down the voltage across the shunt fields of the rotaries, *D*, causing lagging currents to enter the armatures thereof which balance the leading currents and equalize their effect on the transmission system. In this way the load on the system, *C*, can vary in magnitude or phase relation by any amount within limits without affecting the voltage relation at the diret-current terminals of the rotaries.

Methods of Determining the Frequency of Alternating Currents.*

BY CARL KINSLEY,

INSTRUCTOR OF PHYSICS AND ELECTRICAL ENGINEERING, WASHINGTON UNIVERSITY, ST. LOUIS, MO.

The accurate determination of the frequency is essential for the correct computation of the relations between e. m. f., current, self-induction and capacity. Since the periodicity must usually be squared, it is essential that the determination be made quickly and with but little error.

Dr. John Hopkinson was the first to use a stretched steel wire actuated by an electromagnet and when the condition of maximum resonance was found the periodicity was calculated from the constants of the wire and its tension.

Dr. Campbell[1] proposed the use of an iron rod which was thrown into resonance in the same way. From the constants of the rod and its length the periodicity was computed. The rod he found could be more easily used than the wire.

Another method capable of great accuracy and easy manipulation includes the use of a telephone in the alternating-current circuit and a resonance tube by means of which the periodicity may be calculated from equations, or it can be gathered from tables already computed.[2]

A very satisfactory method will be one which includes the use of a metal strip as the primary resonator whose periodicity may be changed by means of an added weight. An electromagnet may be used, as in the first two cases, to set this into vibration. The periodicity can be calculated from the constants of the vibrator[3] or a complete calibration can be made by two determinations. It will usually be more satisfactory to standardize by actually determining the periodicity of two adjustments of the resonator. The equation to be used for that purpose is

$$t^2 = Dl^2M + Kl^4, \text{ when}$$

t = time of one complete oscillation,
l = distance of the sliding weight from the support,
M = Mass of the slider,
l = length of the vibrating rod.

D and K are the constants of this particular apparatus, which may be either calculated or obtained by experiment.

The condition of resonance is obtained with great readiness and the determination may be made with as great accuracy as may be desired.

*Abstract of paper presented to the American Association for the Advancement of Science, Boston, August, 1898.

[1] "Phil. Mag.," August, 1896.

[2] Kinsley, "Phil. Mag.," April, 1898.

[3] Lord Rayleigh, "Theory of Sound."

The Electric Railway as an Auxiliary to Coast Defense.*

BY W. J. CLARK.

The rapid history making of the past few months has caused the mention of certain problems, which a year ago would have seemed ridiculous, to be worthy now of the most serious consideration. While it is unwise to bring up for discussion here ordinary matters of state and national policy, it is conceded, I think, that no matter what differences of opinion exist among us on the question of national extension and aggrandizement there is a unanimous feeling among all Americans that this is now a nation begun with an exceedingly large "N," and that the true policy for its future is to strengthen it in every legitimate way, by displaying American intelligence, inventive ability and commercial shrewdness in such a manner as to make it the strongest of all earth's nations in peace, so as to the better preserve such relationship for all times to come.

Certain of the continental powers of Europe have for several years been encouraging the construction of street railways for the avowed purpose of military expediency, going so far as to grant subsidies or extraordinary concessions where the construction of the line filled in some important link in transportation facilities. The great essential insisted upon has been that in their construction such railways should conform in gauge, special work and curvature with the general steam-railway system of the country so that in emergencies the rolling stock of the latter could be operated over the lines of the former. This would be more especially in the case of besieged cities to afford a means of ready transportation to all points within the line of fortifications without breaking bulk, also to make it possible to transport bodies of troops to any points within such district in the quickest possible manner.

All over the United States information is readily obtainable concerning the steam railway systems, with their trackage, routes and rolling stock, as well as their inter-connections and the possibility of temporarily increasing the facilities of any particular road by combination with others. Such was not the condition, however, as regards electric railways when a few months ago we were all worrying for fear that landing parties from the then supposed powerful Spanish navy might make it temporarily uncomfortable at certain exposed points along our Atlantic seaboard, besides destroying much valuable property. It was suggested, therefore, to the writer that he obtain maps of all the existing street railway lines along the Atlantic and Gulf coasts, show their connections and intersections with the steam roads and other street railway lines, and, so far as possible, suggest how much could be done, should military necessity require it, to cause such street railway systems to become an important auxiliary to the steam lines for rapidly moving troops and supplies to any points required along the seacoast. This work involved examination of the possibilities of making connections with the steam lines, the utilizing of such track as would be possible from its type and the form and character of special work, so that steam rolling stock could, if necessary, be operated over the street railway lines, while the possibilities of using the current of one electric railway to help out congestion upon some other, and all similar matters, were most carefully gone into. The work was most interesting, hurriedly though it had to be done, and, to the credit of every street railway corporation along the coast, it should be said that each and all patriotically responded to requests with the fullest information that could be desired concerning their systems, and expensive maps were furnished freely without charge. In fact, the management of certain important systems were so enthusiastic that, had the War Department requested it, it is probable that many miles of new track would have been built by them without waiting to question the possibilities of its future earning power, or waiting for local franchise rights. Of course, it would not be proper for the writer now to give to the world the entire results of the investigation, but to attain a most important object, and to strengthen our electric railway systems where they are weak, it should be said that stretching along the coast from Calais, Me., to Galveston, Tex., are ninety-two distinct street-railway systems, any one of which might have been an important factor in transportation for military purposes should Spain have made a demonstration against our coast. The aggregate length of these systems is about 6897 miles, and the capacity of some of these for handling traffic to several coast points is simply astounding, it being frequently two or three times that of steam railways which approach the same localities.

*Paper read before the New York State Street Railway Association, Manhattan Beach, September, 1898. Aostracted.

Rails—Their Construction from a Scientific Standpoint.*

BY A. J. MOXHAM.

The problem of wear upon a steam railroad is a very different thing from that of wear upon a street railroad. The rail in steam railroad use presents a clean head, because the rail is not buried. It has to oppose principally a rolling friction, for the number of times per mile that steam railroad trains are stopped is very few, taking a general average. The street rail, on the other hand, has not only to meet this rolling friction, but has to contend with the grit from the surrounding roadbed, and which stops every few feet.

Being unable to reach positive conclusions as to wear from the published authorities and from personal inquiries with the steel experts of the country, or even from our own experience, it was determined to conduct experiments to this end.

The experiments have lasted for three years. The first endeavor was to take broadly a "soft" steel and a "hard" steel for the rails to be tested, securing the difference by carbon alone, leaving all other ingredients as nearly as possible the same. The experiment with these was started in October, '95, and has been continuous ever since. In June, 1896, additional rails were added to the experiment, supplied by the West End Street Railway Company, of Boston, who at that time had determined (with wisdom as will be seen subsequently) upon a steel both hard and ductile. The conclusions, therefore, are based upon what may be described as

Soft steel,
Hard steel, and
Steel both hard and ductile.

The rails (some thirty-three in all) were laid in the South Eighth Street tracks of the Nassau Electric Railroad of Brooklyn. They were laid continuously, so that the same car is obliged to pass over every rail, and therefore each rail is subject to the same wear, and the wear on the head only is considered. Street traffic is ignored. The point was selected as one that would give great wear in a short time, in order to reach early conclusions, as the cars pass this point at extremely short intervals.

Every rail has been measured at two points, taken about 10 feet from each end, in order to eliminate the special wear at the joints. Each rail has two cast iron boxes bolted to the outside, at the points to be measured, to permit access for purposes of measurement without disturbing the road-bed.

There were seventeen rails of low carbon (viz., averaging 0.28); fourteen rails containing high carbon (viz., 0.59), and two were West End rails. The least wear shown was in the West End rail, the hard rail follows a good second, whlie the greatest wear is shown in the soft rail.

The average monthly wear amounted to 0.0007 inch for the West End rail, 0.0012 for the hard rail, and 0.0017 for the soft rail. The results of the experiments are conclusive on this point.

The carbon of the West End rail is practically the same as that of the hard rail, silicon considerably higher; but the real point of difference between the hard rail and the West End rail lies in the lower phosphorus and higher manganese. It is well known that the low phosphorus, accompanied by an increasing manganese, conduces to greater ductility. On this point, however, a word of caution is necessary. Any decrease of phosphorus from what is known as standard in Bessemer steel, viz., 0.10, can only be achieved at a greatly increased cost of manufacture, and therefore, so far as the chemical constituents of the rail are concerned the whole problem to the street railway man is how far it is economical to go in lower phosphorus, the other hardening elements remaining the same. A steel such as represented by the West End rail, or even a steel still lower in phosphorus, it is possible to make—it is purely a question of cost. On to-day's basis an extra cost of $1.50 per ton on the low-phosphorus steel is a low estimate; it would be safer to take it at $2. Taking the average price of girder rails at, we will say, $25, the extra cost of the low-phosphorus would be 8 per cent. What would be the increased wear of the rails?

The average monthly wear of the hard rail is..... 0.0012
The average monthly wear of the West End rail is..... 0.0007

On the face of it it would appear, therefore, that those who could afford it were amply justified in demanding and purchasing the low-phosphorus steel, but there is a hope for those who cannot afford it; and there is some doubt as to the advantages to be gained from so doing, which brings us to the lesson of the whole experiment. Pay close attention to what follows.

*Paper presented before the New York State Street Railroad Association, Manhattan Beach, September, 1898. Abstracted.

We all know that we can use a street rail until at least one-half inch is worn away from the head. On this basis, and taking the average wear of the different rails as shown in the test, it would take

25 years to wear away ½ inch with the soft rail;
35 years to wear away ½ in. with the hard rail;
60 years to wear away ½ in. with the West End rail;

and this is the case of a road which represents not average, but excessive wear; the rails in question having borne the wear of heavily loaded cars running on an average of 30 per hour for twenty hours per day, during the time of the experiments, or a two-minute headway. This means during the busy part of the day less than one-half minute headway, and during the night hours a wider interval. Taking the ordinary line its average headway is less than this, consequently the theoretical wear would be greater. Now all of us who are interested in electric roads and have used girder rails are aware of the fact that we do not get anything like this wear, and this being the case we have got to look to something else besides quality of steel. I think we all know what the cause is, and I am glad to again emphasize it because it discloses a great evil we are still suffering from without realizing it to the extent we should—the defect is in the joints.

Had these measurements of wear been taken at the joints instead of elsewhere the lesson would have been different. Rails are taken out of the track to-day, not because the rail as a whole has reached the point of destruction, but because the joints have become too bad for further use. It must be remembered that the experiments in question have not been extended long enough to show the effects upon the rail of the degeneration of the joints. On the wear at the joints reaching a certain point, the wear of the rail increases rapidly.

In the early days of girder rails the joint question was before us all. It was self-evident, in that the earlier construction was so light that the joints quickly went to pieces. During later years, using a heavier rail and larger and better fitting splice bars, we have heard less of this joint question, for as compared with the earlier joints the track is comparatively smooth. Nevertheless, the evil still exists, and a few years from now those who to-day are deluding themselves in the belief that they have a long life for their existing tracks will awake to find out that even the construction of to-day is wasteful and extravagant in this respect. The joint which is accepted now as being passably fair is reducing the life of the rail to one-half, or perhaps even one-third, of what it should be.

The conclusions we are led to seem to me to be as follows:

First. That for street-railway use, a hard rail will give the best results.

Second. That the most economical way to secure this hardness is by increase of carbon, accepting the manufacturers' standard specifications for the other ingredients.

Third. That the next step should be towards an improvement of the joints.

As is well known to all present, the writer has pinned his faith to the electric-welded joint as settling the question once for all, by making the union homogeneous with the rail and possessing an advantage from an electrical standpoint in the matter of conductivity. Nevertheless the cast-welded method also demands careful consideration. It is certainly preferable to anything in the nature of splice bars that we know of, provided one glaring fault can be overcome—viz.: the softening of the steel that occurs from the large body of hot cast metal located at that point—and it would appear that some means could be devised to overcome this evil.

Fourth. After making the joints perfect what we have termed the "West End rail" would certainly justify its extra cost.

I would caution, however, against the use of carbon as high as 0.59, as that was purposely taken high in what we term the "hard" rail in this experiment, the object being to reach an extreme. Carbon should be limited to from 0.50 to 0.55 with the usual leeway to cover manufacturing contingencies. It also remains a question whether the reduction of phosphorus to 0.08 (which may be done within economical limits of cost) will not give results so closely approximating the 0.05 of the West End rail as to make that figure an economical one.

The great lesson I would once more emphasize is that until you get the joints perfect you need not worry about the quality of your steel; anything in the shape of steel—the very cheapest you can buy—will last longer than the joints will permit you to keep your rails in the track.

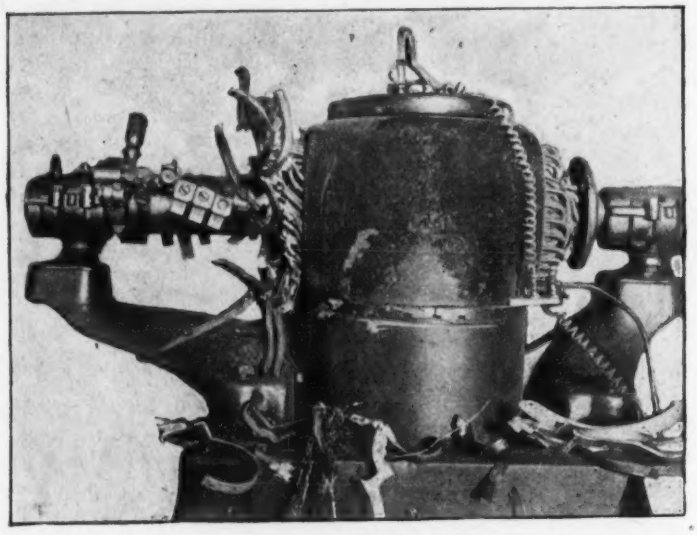
An Odd Wreck.

There appears in the accompanying illustration a view of a 30-kw bipolar compound-wound upright type of dynamo which was, on August 6, subjected to a wreck rather difficult to account for. The details are described as follows by Mr. James T. Freeman, of Rochester, N. Y.:

On the evening mentioned this 30-kw dynamo was called upon to carry a night load of 200 amperes at 110 volts. The load at the time of the transfer was carried by a 75-kw four-pole compound generator of the same voltage. The usual process of bringing the smaller dynamo to voltage and cutting in the equalizing side was carefully gone through with. The instant the main switch was thrown a series of events transpired that came too rapidly to be put carefully on record.

A flash at the switch, the dying down of the lights, the crash of flying material and the throwing off of the belt is the order of events as nearly as they can be given. It would be perfectly useless to attempt to judge from appearances just which happened first, whether the belt was thrown before the commutator went to pieces or after.

The above seems within the range of possibilities, but a look at the machine seems to indicate something different, and makes matters somewhat complicated. The armature indicates in every way that, at the time the commutator was thrown, it was running in a direction opposite to that of the engine. If this was the case the belt was thrown before the commutator went to pieces.



A Wrecked Generator.

The engine, which is rated at 50 horse-power, did not appear to race, and continued running quietly after the accident. The writer, who was present, is sure the dynamo was up to voltage and thinks the attendant at the board pulled the switch almost instantly after it was indicated that something was wrong.

It can be seen in the illustration that the segments indicate a direction of rotation over and toward, while the engine causes a rotation over and from, the point of view.

The dynamo is protected by fuses, but these were not blown. A weakness is found in the commutator, but it would hardly seem possible that at the normal speed of 1300 r. p. m. the centrifugal force alone would cause destruction. It will be noticed that the segments, of which there are sixty, have a short bevel at the ends, and that they are of quite a length. This end of the armature was well protected with canvas and three bands of wire.

The force with which the segments were thrown can be imagined when it is said that one went through a cupboard door 1 inch in thickness, cutting a clean hole; another passed through a window, carrying a part of the sash with it. The oak base presented the same appearance that it would if an inexperienced axman had given an exhibition of his skill at mutilation. The canvas head was torn in shreds, and this, with the mica, was scattered all over the power house.

No one was hurt. The writer had just left a position that was in line of the flying parts. Mauser bullets would have been preferable to the flying segments.

A plausible theory as to the cause, but one which is not corroborated by present indications, is that, after the dynamo was cut in, the shunt circuit became broken, making a series motor, thus changing the direction of rotation.

Track Construction.*

BY D. F. CARVER.

The essential feature of good track construction and good pavement is a good foundation. In a majority of cases this exists naturally at the depth at which ties are laid. If the natural foundation is not suitable, it can be made so by the use of broken stone or gravel.

The ties should be of the best quality of yellow pine, sawed on four sides, and of size sufficient to give a bearing on foundation of not less than 4½ square feet per tie. A very excellent and economical spacing has been found to be twenty-four ties to a 60-foot rail.

All ties should be thoroughly tamped near the rail, and the joint ties tamped throughout their lengths. The dirt under the base of the rail should also be thoroughly tamped, otherwise there will be a settlement, which will allow the rail stones to be forced down.

The rail used should be of hard steel, and of a section that will give it great stiffness. The tread should be either level or, as is becoming common practice, should bevel, so that the wheels will have a bearing for the width of the tread. This latter arrangement gives greater contact for traction and stoppages, and also does less damage to wheels that are skidded in an emergency stop.

The web of the rail should be as nearly as possible beneath the centre of the tread, so that the resultant of the forces of weight and lateral motion of the wheel shall fall within the width of the base. As the lightest section of 9-inch rail is more than amply strong to stand the strain of carriage, provided, of course, that every tie has a first-class bearing, it has been found desirable to roll the web down to the thinnest section possible, and accept the small losses due to rail splitting along the web from the tension caused by the very unequal distribution of metal. The breakage above referred to has been found to be, throughout a year's work, about one-fourth of 1 per cent. of rail laid.

The problem of the rail joint has been a trying one, but it is fast approaching a successful and satisfactory solution, the essential features of which are either a welded joint, which makes a rail practically one continuous mass, or the mechanical joint, which avails of the bearing surfaces beneath the head and tram, and beneath the base, and of the upper surface of the base of the rails which it connects. Either joint, to be entirely successful, however, must be laid with tight joints, so that passing wheels will have a continuous bearing.

This method of construction will, in time, force the track out of line, and where the line is curved to any extent will push the curves out of line; and also in renewing any portion of the track in warm weather, it will be found almost invariably impossible to put in new pieces of the same size as the old removed, because the great compression strain closes up the opening. Still, with all these objections, the added length of life of joints gained is of decided advantage.

With the girder rail sections, in block-paved streets, it is absolutely necessary to use a rail filler. We have experimented with the burnt brick, which was found to crumble badly under heavy wagon traffic, and it has been abandoned. In its place is used hemlock planks, which give the best results on the investment.

In paving up the street the portions outside the outside rail and between the tracks should be paved and thoroughly rammed before the sections between the rails are paved. This prevents the crowding of the stones between rails from forcing the track out of gauge.

A bed of concrete between ties has been tried, to prevent the paving blocks from sinking, but such experience as the writer has had with this construction has not been very satisfactory, and as its first cost is great, and also as the interest on this extra investment is, in many cases, greatly in excess of the maintenance charges which it is intended to prevent, he is led to doubt very greatly its utility.

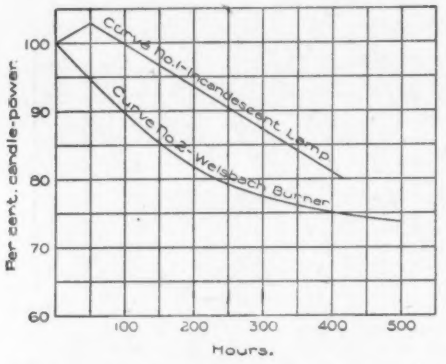
*Paper read before the New York State Street Railway Association, Manhattan Beach, September, 1898. Abstracted.

Deterioration of the Candle Power of Welsbach Mantles.

Gas companies have very generally claimed that the mantles used with Welsbach burners maintain their candle power practically constant until the mantles are destroyed. Recent investigations, however, show that the drop in candle power in Welsbach mantles is as rapid or even more rapid than that of the filaments of incandescent lamps. The accompanying curves, which, with the information, are given on the authority of the General Electric Company, show the average results of a series of tests made on incandescent lamps of its manufacture and Welsbach burners.

Curve 1 shows that a good 32-cp incandescent lamp burns 415 hours before its candle power drops to 80 per cent. of the initial value. Curve 2 shows that a Welsbach burner suffers the same fall in only 230 hours. In other words, the depreciation of the Welsbach mantle is so much greater than that of the electrically illuminated filament that the Welsbach burner drops to 80 per cent. of its initial candle power 185 hours sooner than the incandescent lamp. Even if the drop of the electric filament is measured in terms of its maximum, as some engineers claim it should be, the comparison is but little changed, since 80 per cent. of the maximum is reached only after 350 hours' burning.

Economy dictates the substitution of a new incandescent lamp when the candle power has dropped by at most 20 per cent. of the initial, but taking into account the high first cost of Welsbach mantles and the low cost of operation a mantle would undoubtedly be continued in use until this candle power had dropped much lower. In this case the customer would be obliged to consume the same amount of gas, and thus be at the same expense, although the light obtained would be much diminished in power. For example, if a Welsbach mantle having an initial candle power of 32 were burned for 500 hours its candle power, according to the curve, would drop about 27 per cent., leaving approximately 23.4 candles.



CANDLE-POWER TIME CURVES OF ELECTRIC AND GAS LAMPS.

In 1897 tests were made in Berlin in which two English and three German mantles were tested. The standard of light used was the Heffner amyl-acetate lamp, in connection with a Lummer-Brodhun photometer, the gas being measured by an Elster experimental gas meter. Much care was taken to secure uniform and reliable results, the room being thoroughly ventilated and draughts at the same time avoided, as it has been found that the light is materially affected if there is not an ample supply of fresh air. The horizontal candle power was measured in three directions, 120° apart, and the mean taken as the correct reading, the measurements being taken every twenty-four hours. The final table, which contains practically all the important results, is as follows:

Make of Mantle.	New	Candle Power. 100 Hrs.	Candle Power. 500 Hrs.	Percentage Fall In 100 Hrs.	Percentage Fall In 500 Hrs.
English mantle, No.	1. 36	33.4	14	7.2	61.2
" " "	2. 52.9	49	29.7	7.4	43.8
German mantle, No.	1. 70.3	49.7	28.2	29.3	59.9
" " "	2. 53.5	40.3	33.3	24.7	37.7
" " "	3. 62.6	57.1	47.5	8.8	24.1

An important feature in connection with incandescent gas burners is the proportion of the size of the mantle to the Bunsen flame. In many cases the mantle is much too large for the burner, and in consequence does not become properly incandescent all over; it also shrinks and warps out of shape to a much greater extent than when smaller. The tests also showed that the light absorbed by mica chimneys was about 10 per cent. more than by glass chimneys.

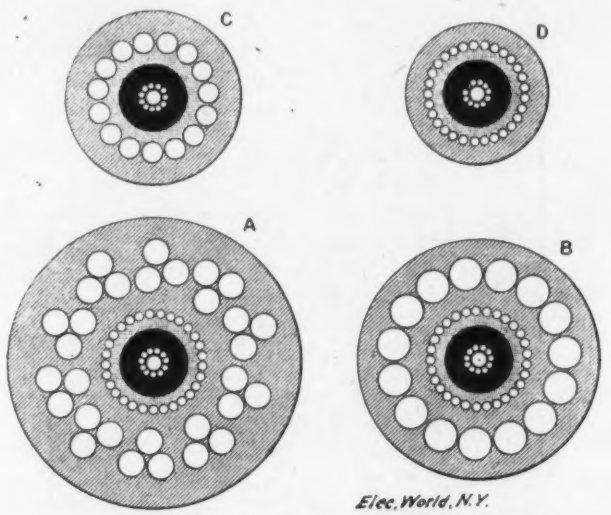
Mr. E. A. Medley, who made the report of these tests, sums up as follows:

"The mantles give a wonderfully good light when new, but the extreme rapidity with which the light falls off and the consequent shortness of their efficient life, even when treated with every consideration due to their somewhat delicate constitutions, make them far from an ideal illuminant. With the possible exception of the German mantle No. 3 a great deal of improvement is necessary before, for domestic lighting at any rate, they can be considered satisfactory."

The deterioration in candle power of Welsbach mantles should be thoroughly considered in connection with the heat given out, consumption of oxygen and contamination of the air, inconvenience of ignition, danger from fire, and other disadvantages which are common to any gas system, and station managers may find from the facts given cogent arguments in favor of eliminating these disadvantages by discarding the Welsbach burner for the more convenient and more satisfactory electric lamp.

The New Cable Between Brest and New York.

The cable which was recently laid direct from the coast of France to New York City, by the French Telegraphic Cable Company, is described in a recent number of "La Nature," from which the following data and the accompanying illustration were taken: The cable has a length of 5700 kilometres (3540 miles), and weighs in the neighborhood of 9,250,000 kilograms (10,000 short tons) of



CROSS-SECTIONS OF FRENCH CABLE, ACTUAL SIZE.

which 5,500,000 kilograms represent the armoring of iron and steel, 930,000 the copper core and 560,000 the gutta-percha insulating sheath. The conducting core is made up of a thirteen-wire copper cable, the central conductor having a diameter of 3.04 millimetres (0.12 of an inch) and the twelve strands surrounding it of 1.06 millimetres (0.04 of an inch). This conductor is surrounded by the gutta-percha dielectric, the thickness of which is 3.5 milllimetres (0.14 of an inch), the weight of this material being about 180 kilograms (400 pounds) per nautical mile. Outside of the copper and the gutta percha, the dimensions of which are uniform throughout the length of the cable, the section differs according to the location. The protecting envelope is made up in four styles, shown respectively at *A*, *B*, *C* and *D* of the illustration. The lightest section is that shown at *D* for deep-sea service, the armoring of which consists of twenty-four steel wires, each with a diameter of 2.29 millimetres (0.067 of an inch). In the intermediate type shown at *C* the steel wires have a diameter of 4.5 millimetres (0.13 of an inch). The coast type shown at *B* has double armoring, the strands of the inside protection being twenty-four in number, with a diameter of 2.29 millimetres (0.067 of an inch), and of the outside, fifteen in number, with a diameter of 6.8 millimetres (0.20 of an inch), while the shore ends shown at *A* are also doubly protected, the inside armoring being the same as the last and the outside made up of ten three-wire strands, each wire of which is 5.6 millimetres (0.16 of an inch) in diameter. The cable is designed to transmit per minute sixteen words of fifteen impulses per word. The cable was built and laid by La Société Industriale des Téléphones.

The Meeting of the British Association.

The sixty-eighth annual meeting of the British Association for the Advancement of Science was held at Bristol, September 8-13, with an attendance of over 2400 members and a list of papers and reports which should form a considerable addition to scientific records. Prof. Michael Foster is the president-elect for the coming year and the next year's meeting will be held at Dover, Bradford having been chosen as the meeting place for 1900.

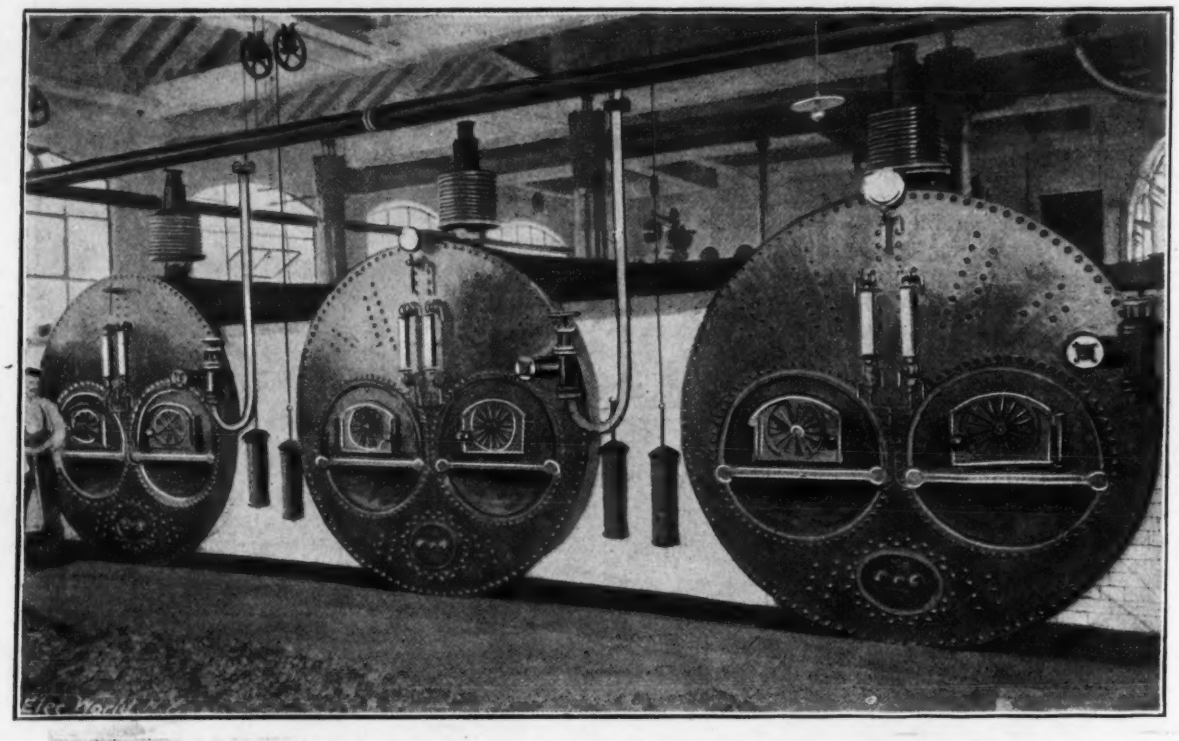
Of the two most notable features of the meeting, one was the cry raised over the disturbances of the measurements in magnetic observatories caused by electric tramways and the dangers of electrolysis from the tramway returns. The English have taken observatory disturbances much more grievously than have Americans, among whom the idea has generally prevailed that, the electric railways being of more vital interest to the public than magnetic observatories, the latter must give way. The other subject which excited considerable interest and on which three papers were read was the electrical transmission and distribution of power. In this line a radical conservatism and a noticeable lack of information on the recent developments in alternating-current work in Switzerland and in this country appeared. One prominent engineer expressed the opinion that wherever the distance did not call for pressures of over 2000 volts direct currents were preferable to multiphase. The papers and discussions in this line brought out practically nothing new to American engineers.

The following is a list of the electrical papers of engineering interest presented at the meeting:

A. A. Cahen and J. M. Donaldson, "Comparison Between Charging a Secondary Cell at Constant Potential and at Constant Current, More Especially as Regards Efficiency"; Prof. Oliver Lodge, "On a Magnifying or Bellowing Telephone"; E. H. Griffiths, "On the Measurement of Small Differences in Resistance"; Prof. H. L. Callendar, "A Platinum Voltmeter"; E. B. Rosa and A. W. Smith, "On the Dissipation of Energy in the Dielectric of a Condenser"; Prof. H. Callendar, "A Quantitative Bolometric Sunshine Recorder"; S. Skinner, "The Carbon-Consuming Cell of Jacques"; J. B. Fawcett, "On Standard High Resistances"; Mrs. Ayrton, "The Drop of Potential at the Carbons of the Electric Arc"; S. Lemström, "Experiments on the Influence of Electricity on Plants"; Dr. E. H. Cook, "The Action of Electricity on Plants"; Discussion on "The Magnetic and Electrolytic Actions of Electric Railways." Communications on this subject were made by Dr. Schott, Prof. A. W. Rücker, Drs. Eschenhagen and von Bezold, W. H. Preece, Signor D. L. Palazzo and Prof. J. A. Fleming. Interim Report of the Committee on Electrolysis. Report of the Committee on Comparing and Reducing Magnetic Observations. Report of the Committee on Electric Standards: A. G. Vernon Harcourt, "On a 10-candle Lamp to Be Used as a Standard of Light." Report of the Committee on the Electrolytic Methods of Quantitative Analysis. E. Cannan, "Ought Municipal Enterprises to Yield a Profit in Aid of Rates?" Prof. S. P. Thompson, "Economic and Social Influences of Electric Traction"; A. Siemens, "Electric Power in Workshops"; A. H. Gibbings, "The Application of the Electric Motor to Small Industrial Purposes and Its Effects on Trade and on the Community Generally"; W. Geipel, "Electric Power and its Application on the Three-phase System to the Bristol Wagon and Carriage Works"; H. Faraday-Proctor, "Notes on the Electric Lighting System at Bristol, with Special Reference to Auxiliary Plant"; Prof. Silvanus Thompson and Mr. Miles Walker, "Electric Traction by Surface Contacts"; J. G. Aldridge, "Combined Electric Lighting and Power Plant for Docks and Harbors"; A. H. Allen, "Electric Canal Haulage"; C. Bright, "On the Pacific Cable."

The Blackpool and Fleetwood Electric Railway.

This English electric railway, though of small size, as are all English electric railways, the total length being 8 miles and the proposed number of motor cars twenty-four, is of considerable interest in that it runs largely over a private right of way and that storage battery sub-stations and other unusual electrical arrangements are used. The line is described fully in "The Railway World" of September 8, 1898, from which the following information and cuts were taken. The greater part of the line is practically a light railway construction with centre pole and bracket overhead wire supports, the speed on this part of the line being quite high, the whole 8 miles being covered in twenty-five minutes, which could be diminished were it not for official regulations. The motor cars are all of the double-truck type, weighing loaded 12 tons and fitted with one G. E.-1000 motor per truck.



The Boilers of the Blackpool and Fleetwood Electric Railway.

The generating station contains three Galloway boilers and four open marine-type vertical two-crank compound engines rated at 200 horse-power, each driving at a speed of 165 revolutions per minute, a six-pole, 120-kw 505-volt generator, both engines and generators being built by Messrs. Mather & Platt. The cut-off of the engines is varied by hand and the automatic governing is effected by a throttle governor. Ejector condensers take the exhaust. The generators have some peculiarities unknown in this country. In the first place they are shunt wound, the chief feature of interest, however, being a collar (apparently of iron) encircling the armature from pole to pole. This arrangement is said to effectually prevent all sparking, this advantage more than compensating for the

magnetic leakage which it entails. The efficiency of the generators is given as 93 per cent., no parts rising more than 25° C. above the atmosphere on continuous full-load running. Three four-pole motor-driven boosters also mounted in the station are capable of building up 200 volts with a load of 130 amperes each. By means of switches any one of the four feeders may be connected to a booster. Two feeders run respectively to two accumulator substations toward the ends of the line. Each of these is fitted with 250 cells made by the Chloride Electrical Storage Syndicate, having a capacity of 300 ampere hours. The batteries are normally "floated" on the line to steady the load coming over the feeder, but any one of the three elements, the battery, feeder or line, may be cut out by switches.

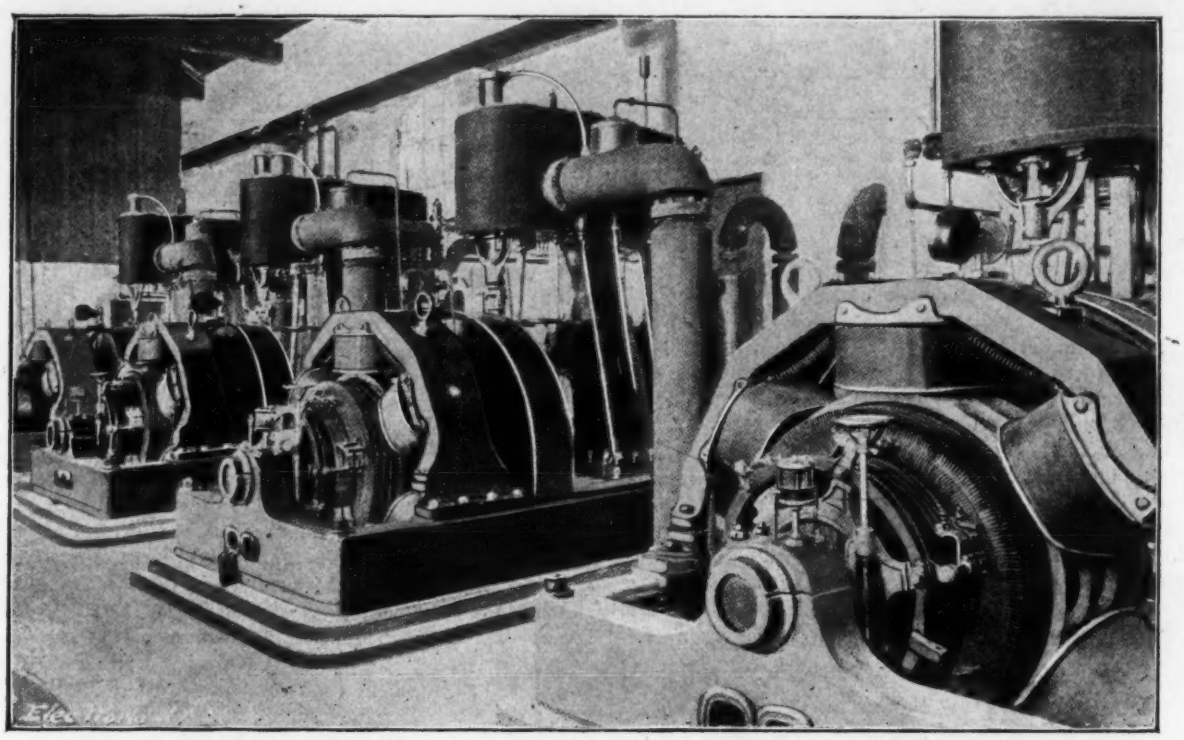
Electric Belts.

The country newspaper having a circulation among farmers and the religious weekly having a circulation among families seem to be the principal places in which one reads advertisements of "electric belts" for the cure of all kinds of disease to which the human frame is liable. As has been pointed out recently in these columns, it seems to be the duty of the electrical press to expose, wherever possible, the fakirs who do so much to bring the profession into discredit and to throw a certain obloquy upon the name of things electrical. Among these are the enterprising manufacturers of the remarkable mechanisms known and advertised as "electric belts." The advertisements guarantee the wearer of one of these an immunity against pretty nearly everything but a violent death, and generally tell, in learned terms, about the benefits to be derived from the more or less powerful currents of electricity generated by their appliances and absorbed into the system of the wearer.

In the first place, if it were true that the beneficial results to be derived from the application of electric currents to the body amount to the half of what these fakirs claim the use of electricity ought to be carefully restricted to practitioners who understand its application. So powerful a medicament can only be dangerous in the hands of the unenlightened, for all the agents of the pharmacopœia that possess great curative power are also able to do equally great damage if wrongly or ignorantly administered. This view of the matter is, however, based upon the purely gratuitous assumption that electric currents have any directly beneficial effect upon the system. If this be true, it certainly is not proven. While, in the hands of competent specialists, the use of electricity in the treatment of disease is a recognized and valuable means, it by no means follows that the mere putting of part of the body in an electrical circuit will have any effect whatever, save a disastrous or at least uncomfortable one, if the current is strong enough. Hence the pretensions of the makers of electric belts are ridiculous, even assuming that their contrivances produce a current at all.

As a matter of fact most of them do not produce a current of measurable volume. They are generally made of bits of copper and some other metal, cut into more or less fantastic shapes, and grouped together in a structure such that they are in contact with the skin of the wearer. Under these circumstances there is, no doubt, some potential difference set up between the metals, but it is, of course, immediately destroyed by the metallic contact between them. If it were not—that is, if there were a genuine potential difference maintained between particles of dissimilar metals in contact with the human skin—the phenomena of cataphoresis would certainly ensue and the substance of the metals or their oxides would be carried locally into the wearer, who would discover this fact by the breaking out of sores where the belt was in contact with him. As a general thing the makers guard against this unhappy possibility by so elaborately short-circuiting their metals that not a trace of a volt can be found anywhere about the belt.

The whole thing is ridiculous, were it not for the fact that sick people are swindled out of their money by the purchase of these things. It is possible that they even sometimes perform a genuine cure, if the disease afflicting the wearer is of nervous origin and he has sufficient faith. It is well known that a potato carried in the pocket will cure those who think they have rheumatism. So will an electric belt, but the potato is just as good and cheaper.



A VIEW OF THE MAIN GENERATORS OF THE BLACKPOOL AND FLEETWOOD ELECTRIC RAILWAY.

To Prevent Over-production of Acetylene.

In order to avoid over-production in acetylene generators, in which the pressure of the gas lowers the water from the carbide, from moisture remaining after production should be stopped, it has been proposed in a communication to the French Society to steep the calcium carbide in hot concentrated solution of glucose. In the subsequent production of acetylene a sucrate of lime is formed by the action of the glucose, the calcium and the oxygen, which stops the generation almost immediately on the cessation of the water supply.

An Important Patent Decision.

It has just been decided in the United States Circuit Court at Detroit, Mich., that the lapse of a foreign patent after the filing of the application for United States patent, but before the issuance of the latter, does not affect the term of the subsequent United States patent. This is said to be a favorable precedent for the Welsbach Company in its suit for the control of the incandescent gas mantle.

A New Telephone Repeater.

BY KEMPSTER B. MILLER.

The question of telephone repeaters seems to occupy an important place in the minds of many of our foremost telephone engineers, in spite of the somewhat discouraging views on the possibilities of the repeater expressed by Mr. Thomas D. Lockwood in a most interesting series of articles entitled "Telephone Repeaters or Relays, and Repeating Systems," published in THE ELECTRICAL WORLD in November, 1896.*

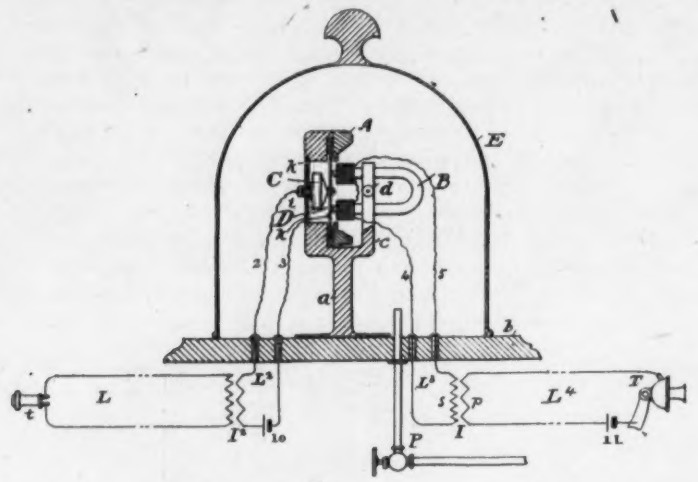


FIG. 1.

A patent has just been issued to Mr. John Stone, of Boston, and assigned to the American Bell Telephone Company, which is well worthy of consideration. While no new circuits and, in fact, no new mechanisms are embodied in this invention, the results claimed are said to be superior to any heretofore attained in this line of work. The repeater, together with the circuits of the two communicating lines, is shown in Fig. 1, in which T is the transmitter of the sending station and t is the receiver at the receiving station. These are connected with the repeater by the lines L^4 and L respectively, the line circuits being associated with the repeater circuits by induction coils I and I^2 in the usual manner. B is a polarized electromagnet whose poles are in proximity to the diaphragm D. C is the variable resistance button of a transmitter, the front electrode of which is secured rigidly to the centre of the diaphragm D, while the back electrode is rigidly secured by means of the cross piece i to the frame A, which also supports the diaphragm D and the electromagnet B. The variable resistance button is shown in section in Fig. 2, and will be at once recognized by those who are familiar with the solid-back transmitter as being nothing else than the button used in that very efficient form of instrument. So far the apparatus described certainly embodies no new principles. The transmitter T serves to vary the resistance of the circuit of line L^4, and thus to vary the current strength of the battery 11. The fluctuations in the current thus produced act inductively through the induction coil I and cause corresponding currents of somewhat higher tension to flow in the circuit L^2 containing the coils of the receiver magnet B. This acts on the diaphragm D, which is of iron, in precisely the same manner that an ordinary telephone receiver acts on its diaphragm, and the vibrations of this diaphragm cause the transmitter button C to vary the resistance between the front and back electrodes m and m^2 respectively. This causes fluctuations in the current flowing from battery 10 through the circuit L^2 and these in turn act inductively on the receiving circuit L, thus reproducing the original sound in the receiver t.

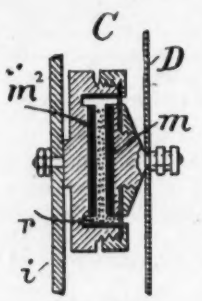


FIG. 2.

The only feature of alleged novelty in this patent is the fact that the entire working parts of the repeater are inclosed in a chamber E, from which the air may be exhausted to any desired extent by means of a pipe P and any suitable air pump. Just why this gives better results than the ordinary form of repeater is not explained in the specification of this patent, but it is obviously due to one or both of the following causes: first, the removal of the air from the chamber will undoubtedly allow a freer vibration of the diaphragm and its mechanism; and second, the layer of occluded air between the granules of the carbon, to the presence of which Mr. Berliner attributes the action of the microphone, is made thinner if not removed entirely. Probably the former, and not the latter, is the cause for any superior results which this repeater may produce, as Professor Fessenden has, I think, quite clearly shown that Mr. Berliner's occluded air theory plays little if any part in the true action of the microphone.

Concerning the results obtained with this repeater, Mr. Stone says, "The messages automatically transferred by it from one circuit to another are reproduced in the receiving telephone of the second circuit with a well defined gain in volume or loudness, and without any substantial distortion or off-setting loss in clearness of articulation."

*Vol. XXVII., pp. 593, 626 and 660.

M. Boucherot's Device for Starting Induction Motors.

As is well known the polyphase induction motor requires, to give high torque on low-current consumption at low speeds, a high resistance in the secondary member, which resistance should be reduced to dead short circuit for efficient running and good regulation as the speed approaches synchronism. An ingenious arrangement for accomplishing this change of resistance without the use of sliding contacts of any kind is described in the London "Electrical Review" of September 2, the arrangement being the design of M. Boucherot. The primary element—which is the external stator—is divided into two parts independently wound, each consisting of the ordinary ring-shaped core of slotted stampings, one being fixed to the framework and rotatable by a hand lever or screw device through one pole angle. Both primaries act inductively across the air gap on the secondary of one rotor of squirrel cage construction, the bars of the one secondary winding running through and taking the induction of both primaries. The squirrel cage is short-circuited at its ends, but at its middle, between the two primaries, the bars are joined together by a strap of high resistance material. In starting, the movable primary is so set that the electromotive forces set up by the two primaries in the bars of the secondary oppose each other, and any currents resulting must find their paths from bar to bar through the high-resistance strap. As the motor gains speed the movable primary may be rotated until its electromotive forces act in conjunction with those of the stationary primary to set up currents in the squirrel cage bars from end to end, the resistance to the flow of these currents being very small; thus the resistance is varied without the use of sliding contacts, but by varying the relative angular position of the two rotating fields.

A Long Underground Telegraph Cable.

The British post office is now laying an underground cable for telegraph service between London and Birmingham, a distance of 105 miles. The new cable is intended to supplement and not to supplant the overhead service and is rendered necessary by the crowded conditions of the pole lines on available routes. The cable will carry seventy-six copper wires, paper insulated, and twisted in thirty-eight pairs. The wires are enclosed in a lead tube 2½ inches in diameter, and this will be drawn into 3-inch iron piping laid about 30 inches below the surface. The wires in their lead casing are made up in lengths of 150 yards and the jointing between wires is effected by means of copper sleeves. At intervals of 5 miles the cables are brought to the surface and fanned out in terminals for testing purposes. These way stations will also be fitted with apparatus for pumping chemically-dried air into the cable to maintain a pneumatic head that will keep out moisture which might otherwise enter through faults in the casing. The cable will allow considerable of the overhead wire now used for telegraph purposes to be put into the telephone trunk-line service.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE
AMERICAN AND FOREIGN
By Carl Hering.

Dynamos, Motors and Transformers.

ELECTRIC GENERATORS. Parshall and Hobart. Lond. "Engineering," Aug. 26.—In this continuation of their long serial (see "Digest" Sept. 3) they show briefly by means of an example how to calculate the magnetic circuit of a transformer, a fuller description of which is to be given later. They then discuss the magnetic circuit of induction motors, showing how it is to be calculated; this does not admit of being abstracted. A number of examples are given which relate to matters that have been treated in their articles.

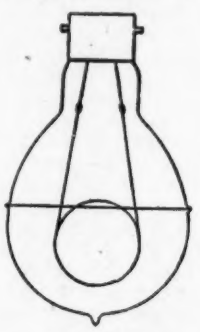
DYNAMOS. Guilbert. "L'Eclairage Elec.," Sept. 3.—Illustrated descriptions of some improvements in dynamos taken, apparently, from patent specifications. The portion concerning the Remon-Casas dynamo is translated in the present issue of THE ELECTRICAL WORLD.

CALCULATING THE FALL OF VOLTAGE IN A TRANSFORMER. Kapp. "L'Eclairage Elec.," Sept. 3.—A long abstract in French of the article noticed in the "Digest" May 7.

Lights and Lighting.

NERNST INCANDESCENT LAMP.—"Elek. Zeit.," Sept. 8.—The announcement recently made of this new lamp has given the impression to the layman that the present electric light stations will soon be superseded with something entirely new, and it has, therefore, been a check to the erection of new stations. The present note contains a letter from Nernst in reply to an inquiry from the editor asking for a statement. He states that no further information can be given at present regarding the lamp, as it is still in the experimental stage; it is certain, however, that the lamp will be made in practice in such a form that it can be connected directly with existing continuous or alternating current stations of 100 to 220 volts; there is, therefore, no need to fear that the introduction of this lamp will make any change in projected installations.

MAXIM INCANDESCENT LAMP.—Lond. "Elec. Rev.," Sept. 9.—A short, illustrated description of a lamp with a support for the filament. It consists of a narrow strip of mica with slots in it, through which the filament passes, holding it firmly in position; the lamps can therefore be hung in any desired position without the filament bending; it also steadies the filament during transportation. The mica is not sealed into the glass, but is sprung into two small pockets in the widest part of the bulb. It is claimed Maxim's experiments have resulted in the production of a 2.8-watt



lamp which compares favorably in light and maintenance of candle power with the average 4-watt lamp.

Power.

POWER INSTALLATION AT BIRSFELDEN.—"Zeit. f. Beleucht.," Aug. 30.—An abstract of the project which is likely to be carried out at this place, near Bale, Switzerland, and which is to supply current and power to Muelhausen and other neighboring places; the fall of the Rhine is used; the installation is to be one of 7000 horse-power.

GAS ENGINE V. ELECTRIC MOTOR.—"Prog. Age," Sept. 15.—An abstract of an article comparing the costs of a small gas engine with an electric motor in the city of Cologne, Germany. Some of the advantages of the electric motor are recognized, but in regard to economy the advantages are in favor of the gas engine; for steady working the gas engine is cheaper by more than 50 per cent., or when used only half the time there is still a saving of 40 per cent. The conditions on which the calculations are based are those existing in that city. The gas engine and motor are both 4 horse-power; the former requires 91.8 cu. ft. of gas per hour, and the latter 3.8 kw per hour; the interest is 4 per cent. and the wear 7 per cent. The total cost per year of the gas engine is about $315, of which the cost of the gas at 2.5 cents per c. metre is somewhat over half; the total cost of the electric motor is $690, by far the greater portion of which is the cost of the current at 5.5 cents per kw hour; the cost per horse-power is 2.6 cents for the gas motor and 5.8 cents for the electric motor. The less they are used the nearer will the electric motor approach the gas engine in economy.

WEST KOOTENAY.—"Can. Elec. News," Sept.—An illustrated description of this long-distance plant for power and light. The Bonington Falls in British Columbia is the source of power, and the current is transmitted to Rossland, a mining centre, 30 miles distant. The falls yield 60,000 horse-power, of which 20,000 is to be developed. All of the machinery is Canadian; there are two three-phase generators of 75 kw and a frequency of about 60; the current is generated at 1100 volts, and is stepped up to 11,620 for the delta connection or 20,100 for the Y connection. The pole line is described in detail, and is said to embody the most improved practice; the difficulties caused by wet snow are so great that the line wires are housed. Medium hard-drawn copper is used for the line. The plant has been in operation for two months.

Traction.

COMBINED ACCUMULATOR AND TROLLEY TRACTIONS. Scott. Lond. "Elec. Rev.," Sept. 9.—The conclusion of his article (see "Digest" last week). He gives a table containing some data for the various electrical and other systems used in Paris. The cable line seems to be the cheapest, after which comes the Serpollet steam system, while the compressed air system is the most expensive; the accumulator system lies about midway; fair dividends have been earned by each of the companies. A short description of the accumulator system in Paris is given. One of the advantages of the combined trolley and accumulator system is in the case of fire, as when the wires are cut down the accumulators can supply the power; also that bonding can be dispensed with in that section of the line where the trolley wire is forbidden, and it is always in the closely built up portion of the city where the electrolysis of pipes is greatest; there is no reason why the accumulators should not be removed at the junction of the trolley wire section.

SURFACE CONTACT SYSTEM.—Lond. "Engineering," Aug. 26.—An illustrated description of the Kingland system, which is on exhibition in London. It is claimed editorially that in this the irreducible minimum of mechanism seems to have been reached, the mechanical and electrical features being the simplest possible and being entirely free from all delicate detail. This is a system in which the third rail is divided into insulated sections, each of which is made alive successively by the car passing over it. The switching apparatus, of which there is one to each section, consists of an electromagnet with two pole pieces, between which there is a soft iron armature, which revolves on an axis, which also carries cylindrical commutators; as the armature is moved through an angle the necessary switching is accomplished by these commutators. Besides the main commutator there is an accessory one, which operates the electromagnet itself, and the current through it is started by the car touching the next insulated rail section in advance of the one in use, thus causing the current to pass through the magnets to earth. The device serves equally well whether the traffic is in one or both directions on the same track; a diagrammatic illustration of the device is given.

GORNERGRAT MOUNTAIN RAILWAY. Berthier. Cosmos," Sept. 10.—A short, illustrated article on this electric rack and pinion mountain road, operated by three-phase currents, to which other references have already been given. The present article contains a plan of the routes, several views, the truck of the locomotive which operates the pinion, and details of the rack.

THE PASSING OF ELEVATED RAILWAYS.—"Eng. News," Sept. 15.—An editorial stating that the four elevated electric railways in Chicago, although well built and efficiently operated, do not pay as business ventures; the chief reason of the failure is found in the rapid evolution of the surface railways from horse cars to electric and cable lines. The mass of the traveling public prefer surface roads whenever these approach even moderate standards of speed and service; including stops, the elevated railroads make only 11 to 15 miles an hour, while the electric railroads in the outlying stations often do nearly as well. Under these conditions it is thought to be clear that we have about seen the end of elevated traction, except in some cases where peculiar local conditions occur, as in the crowded districts of Boston and the long distances down Manhattan island.

CLEVELAND. Fairchild. "Elec. Eng.," Sept. 15 and 22. The conclusion of the illustrated descriptions of the cross country roads leading out from Cleveland (see "Digest" last week). The Akron, Bedford and Cleveland, the Lorain and Cleveland, and the Cleveland and Chagrin Falls lines are described.

Installations, Systems and Appliances.

REGULATION OF VOLTAGE IN ALTERNATING CURRENT INSTALLATIONS. Meyer. "Zeit. f. Beleucht.," Aug. 20 and 30.—An illustrated article in which, after briefly discussing various systems which have been proposed, he describes the fol-

lowing, by means of which the voltage at the ends of the feeders of an alternating-current circuit can be kept constant without any difficulty, and in many respects in a much simpler way than with continuous currents. From the distributing points two wires run back to the station, where they are connected to the secondary coil of a transformer, the primary of which is connected to the poles of the generator; these two coils are connected in opposition to each other; they will, therefore, neutralize each other as long as the voltage at the feeding points is normal; if this voltage falls, however, the current in the primary will be greater than that in the secondary, and the magnetic equality in the transformer will be disturbed, thus generating a current in the secondary coil, which flows to the point of distribution, thereby raising the voltage to the normal. It is evident that the lines leading back from the feeding points must be so proportioned that they can carry this extra current; (but how great this increased cross-section is likely to be is not stated; it would seem that it might be quite great). In many cases it is desired that the voltage at two pairs of feeding points should be kept alike; in this case he applies the same method except that the transformer coils are connected respectively to those points, and not to the generator. In a similar way it is possible to regulate the steam engine or turbine which drives the generator, by making use of the current flowing in this transformer circuit. The method may also be applied to multiphase installations, which he illustrates, the main principle remaining the same. In conclusion he gives a brief theoretical discussion.

STORAGE IN A CENTRAL STATION. Low. "Jour. of El'ty," Aug.—A long, well-illustrated description of the electric storage plant in the Edison station in San Francisco, which has a generator output of 2200 kw; the battery was added in preference to enlarging the generating plant, and has a capacity of nearly 1000 kw hours for one hour; complete engineering data of the battery are given. It consists of two series of seventy-five cells each, nineteen of which are used as regulating cells. The plant is exceeded in size only by the one in Chicago, and is equal to those in Philadelphia and Hartford. The capacity of the battery at various rates of discharge is given in a table.

CENTRAL STATION STATISTICS.—"Sc. Am. Sup.," Sept. 14.—A reprint of two tables of statistics of central lighting stations in the United States, operated by private corporations and by municipalities; the figures are given for each State, and contain ten well-filled columns of data for each; the compilation was made from the late reports of the American Electrical Directory. The totals for stations operated by corporations are as follows: Total number of stations, 2261; capital stock, $229,938,605; number of arc lights, 264,428; number of incandescent lights, 7,234,134; engine power, 970,481. For the stations owned by municipalities these figures are as follows: 333 stations, 26,087 arc lights, 371,440 incandescent lights, and 67,740 horse-power.

Wires, Wiring and Conduits.

RELATIVE COST OF COPPER AND ALUMINUM. Zingler. Lond. "Elec. Rev.," Sept. 9.—A brief reference to Kershaw's recent article (see "Digest" last week). He claims that Kershaw has simply substituted the English market values for those in America. He does not think any claim is ever put forward for insulated aluminum wires, but for bare aerial transmission purposes the following advantages may be pointed out: For equal conductivity, aluminum has half the weight of copper, and about the same breaking strain as copper, if not more; therefore, for equal conductivity the spans may be about double those for copper wire; for equal conductivity with aluminum at 29 cents per pound the cost is nearly the same as of copper. It is therefore evident that there is a great saving in the carriage, labor, posts, insulators and maintenance; the difficulty of the joints is an artificial one, as there are plenty of good mechanical joints.

CABLE SUBWAY UNDER THE MILWAUKEE RIVER.—"Eng. News," Sept. 15.—A note stating that the 4-ft. subway has just been completed by the Milwaukee Electric Railway & Light Company. It is made of cast iron pipes, which are filled with 3-inch ducts, of which there are 110. Two similar subways are to be built soon.

CABLE SUBWAYS.—"Eng. News," Sept. 15.—A note stating that a system of electric subways is to be built at once by the city of Baltimore, for accommodating all overhead wires except trolley wires. One million dollars is appropriated for their construction.

Electro-Physics and Magnetism.

B. A. PRESIDENTIAL ADDRESS. Crookes. Lond. "Elec.," "Elec. Rev." and "Elec. Eng."—Long abstracts of portions of his presidential address to the British Association, which met at Bristol. Portions of the address were given in the last issue of The Electrical World. The second portion of his address is a critical review of recent progress in various branches of physics. In connection with Röntgen and cathode rays he states that the drift of scientific evidence supports a transverse ether theory of Röntgen rays and an atom-stream theory of cathode rays. The nature of the atom is then discussed, including an ingenious speculation concerning the behavior of uranium, the atoms of which are conceived to have the power to abstract energy from their environs by the process of sifting the more rapid molecules of which the environment is composed. He also makes the first announcement of his discovery of a new element, which he calls monium.

USE OF SIMPLE SINE CURVES IN PROBLEMS. Rhodes. Lond. "Elec. Rev.," Sept. 9.—Bedell, Boyd, Steinmetz and others have argued that for purposes of calculation it is generally quite admissible to replace the actual curve of an alternating current by an equivalent sine curve, which is defined to be that which has the same root mean square value as that of the actual curve under consideration. It appears, however, to be thought that this substitution is legitimate only when the even harmonics are absent, and this, the author thinks, is erroneous, giving in the present article his reasons for saying that it is correct whether the harmonics are odd or even. The condition for this substitution is that there must be only one simple sine curve for given combination of fundamental and higher harmonics—that is, the root mean square value of the actual curve must depend only on the magnitude of the harmonics present, and not on their positions relative to the fundamentals and to each other. He then gives a short, mathematical proof, showing that the power given to the circuit depends only on the maximum value of the fundamentals and harmonics, and on the difference of phase between each component of the current curve and the corresponding component of the voltage curve and these differences of phase are dependent solely upon the time constants of the circuit. It appears, therefore, that in ordinary calculations we may with accuracy assume the e. m. fs. and currents to be simple harmonic functions of the time, provided their root mean square values are taken to agree with the readings of an electrostatic or hot-wire voltmeter and their mean product with the reading of a wattmeter.

MARCONI COHERERS. Blondel. "L'Eclairage Elec.," Aug. 20.—An abstract of a French A. A. S. paper. He calls attention to the great difference between the Branley tubes and the Marconi coherers; with the latter the effect of different metals for the filings can be studied; it appears that the condition for a metal to give good results is that it should be covered with a layer of oxide which is very thin and not too poorly conducting. The results of his investigations show that the Marconi coherer has been well designed, being very sensitive and reliable. He suggests that it might be improved by making the vacuum regenerative by means of a small pocket containing filings.

REACTIONS OF THE COHERER. Leppin. "Wied. Ann.," No. 8; abstracted in the Lond. "Elec.," Sept. 9.—Auerbach showed that the coherer also reacts in the case of sound waves; the present author shows that the coherer is also a sort of microphone, thermometer, and photometer. Inserting a Branley coherer as a microphone, all sounds were distinctly transmitted and reproduced in the telephone; the approach of a hand produced a deflection due to the heat; daylight produced a deflection after a few minutes; the effect is thought to be due to heat only and not to light. These experiments are of importance as showing in what direction disturbances in the normal action of the coherer may be looked for.

ALUMINUM ELECTRODES. Wilson. Lond. "Elec. Rev.," Sept. 9.—A long abstract of the article, a complete reprint of which was noticed in the "Digest" Aug. 6, 13 and 20. A German abstract, with some of the curves, is published in the "Elek. Zeit.," Sept. 8.

ANTICIPATION OF GALVANI AND VOLTA. Lond. "Elec.," Sept. 9.—An extract from the "Dundee Advertiser," Aug. 29, in which certain interesting anticipations are cited. In 1780 Domenico Cotagno found that the muscles of the leg of a mouse which he was dissecting were contracted when touched by the knife; Jean Jallabert, in 1748, published his "experiments in electricity" and gave his theory of dynamical electricity in 1767, founded on the phenomenon produced by placing two metals with the edges in contact, while the rest of the plates were separated by a damp cloth; it seems to be an anticipation of the Voltaic pile. Johann Georg Sulzer, in 1767, called attention to the sensation of taste produced when a piece of lead and a piece of silver are laid above and below the tongue and brought into contact with each other; (in the extract quoted he does not, however, connect this with any electrical phenomena). In 1700 Joseph Du Verney produced the same contraction of the muscles with two moistened metals as Galvani noticed in 1791. Verney also successfully inoculated some of the members of the Royal French family with cowpox to protect them from smallpox about a century before Jenner made his first experiments. Editorially it is stated that Swammerdan, in 1678, showed that when a portion of a frog's leg was hanging by a nerve bound by a silver wire held over a copper support, so that both the nerve and the wire touched the copper, the muscle contracted.

QUANTITATIVE STUDY OF THE HIGH-FREQUENCY INDUCTION COIL. Boynton. "Phil. Mag.," Sept.—A very long article in which he develops a mathematical theory of the so-called Tesla coil: it is a modification and expansion of Oberbeck's theory, and is essentially a discussion of a system with two degrees of freedom. After developing the theory he describes the apparatus and experiments with which he made quantitative tests to verify the theory. His conclusions are as follows: "1. The main period of oscillation of the primary circuit is very nearly that deduced from the dimensions of the system. The same may be said also of the maximum potential attained in the secondary circuit. 2. The effective currents and potentials, which are functions of the damping factors, and these in turn of the resistances, would indicate that the resistances of the sparks are of the order of from 10 to 100 ohms, depending upon the amount of current flowing through the spark. 3. It appears that when the secondary circuit is closed by a spark the primary current decreases with the length of this spark; but the secondary current decidedly increases. It

still remains to be shown whether this is due to the conditions of the experiment, or is to be explained by a more accurate application of theoretical reasoning." (A similar article in an American journal was noticed in the "Digest" Aug. 6.)

TERRESTRIAL MAGNETISM. Cotterell. Lond. "Elec. Rev.," Sept. 9.—The first part of an article discussing the various possible theories to explain this magnetism and claiming that it is impossible to construct any hypothesis having for its fundamental principle the idea of a material magnet. He seems to question whether the earth is a huge magnet or merely the recipient of an ethereal line of force.

ELECTROMAGNETIC EFFECTS OF ELECTROLYTIC CURRENTS. Sheldon and Downing. "Phys. Rev.," Aug.—A short article describing experiments in which they endeavored to determine whether a current through an electrolyte produced magnetic effects of the same magnitude as those which it did when it passed through a metallic conductor. According to modern theory electrolytic conduction takes place by convection, which is not true of metallic conduction; it was, therefore, thought that the magnetic effects might possibly also be different. The apparatus was similar to that used in determining the magnetic qualities of iron by the method of reversals; a coil was wound around the iron, consisting of a rubber tube filled with the solution, and this was then replaced by a copper wire. The results seem to be practically alike, and appear to indicate an inconsistency between the accepted ideas of the two kinds of conduction as based on the two-fluid theory, but they seem to be in accord with the single-fluid theory; in the latter but one set of ions carries the magnetically active charge, and the electrolytic ampere turns should then produce the same effect magnetically as the metallic ampere turns.

HIGH-FREQUENCY EXPERIMENTS.—"Sc. Am. Sup.," Sept. 10.—An illustrated description, taken from "La Nature," of various experiments recently shown by Radiguet, and similar to those performed by Tesla, except that he used the Oudin resonators of great frequency.

QUANTITATIVE STUDY OF THE HIGH-FREQUENCY COIL. Boynton. "Phys. Rev." Aug.—Several plates, which should have accompanied the article which was published in Vol. 7, No. 1 (see "Digest" Aug. 6).

Electro-Chemistry and Batteries.

DIFFUSION IN ACCUMULATORS. Juman. "L'Eclairage Elec.," Sept. 3.—The capacity of the positive plate depends partly on the quantity of the peroxide and partly on the quantity of acid which can enter into combination in the reduction of the oxide; the discharge may, therefore, be limited by either of these. If by the coefficient of utilization of the material is meant the ratio between the lead engaged in the reaction and the total lead in the active material, then this coefficient can easily be 0.7 in plates having a very thin layer of active material, while it may be as low as 0.2, or even lower, for thick, positive plates in which the complete utilization of the material is impossible on account of the bad conductivity of the sulphate formed and the lowering of the e. m. f. when the proportion of sulphate becomes too great. Theoretically the amount of lead required is 3.86 grams per ampere hour, or 4.45 of peroxide of lead; when the coefficient of utilization is 0.7, 6.36 gram of the peroxide will be required, while if it is 0.2, then 22.2 grams are necessary, showing the great importance of the diffusion of the acid in the material. The quantity of acid necessary for the reactions can be divided into two parts, one part in the pores of the active material itself, and the other from the diffusion of the acid of the electrolyte; the latter is proportional to the surface of diffusion, the difference of concentration, and the time; this partially explains the variation of the capacity with the porosity of the material, the density of the liquid and the strength of the current; the available surface is always very small, and is made up of pores, and these are reduced by the sulphating, which increases the volume of the material. If his opinion is correct the capacity of the positives when the active material is in excess ought to vary, not only with the porosity, the density of the electrolyte, and the current, but also with the previous state, as after a slow discharge the quantity of sulphuric acid in the material will be greater than after a rapid one, which gave less ampere hours; it is this which he endeavored to verify by the experiments which are described in the article. In these tests he charged and discharged a plate successively, commencing with small currents and increasing the current progressively in each discharge up to a maximum; then decreasing the current again to the minimum in successive discharges, and completing the cycle by again increasing it to the maximum; during each charge and discharge the current was kept strictly constant; the experiments were repeated by discharging to 1.80 and 1.70 volts; also with electrolytes of density of 1.116 and 1.162 at the end of the charge. The results are given in curves and tables. The curves indicate a true hysteresis phenomenon, showing that the capacity for the same rate and under the same condition is a function of the previous states. The phenomenon is more marked as the density of the electrolyte is less, and it is scarcely noticeable when the densities were higher than 1.21. He then discusses the data, drawing some conclusions with reference to the acid in the pores of the plates.

THEORY OF ACCUMULATORS. Dolezalek. "Wied. Ann.," No. 8; abstracted briefly in the Lond. "Elec.," Sept. 9.—He attempts to explain how it is that 94 to 97 per cent. of the current can be gotten out, while the efficiency (in watts) does not exceed 75 to 85 per cent.; this is due to the differences in the charging and discharging voltages; but it is often erroneously supposed that this difference is accounted for by the losses in the process of diffusion by which the concentration of the acid in the pores of the active mass is equalized. The author maintains that the equalization is not carried out by diffusion, but by concentration currents; this is rendered apparent by suddenly reversing the cell, when the charge potential is not assumed immediately. The loss of energy in the accumulator is governed by thermo-dynamic laws, and is equal to the heat produced by the concentrations currents between layers of variously concentrated sulphuric acid in the spongy mass. A formula which he gives represents this law and shows that the loss approaches the vanishing point when the currents are feeble.

ALLEGED DECOMPOSITION OF SULPHUR. Alexander. "Zeit. f. Elektrochemie," Aug. 25.—In an article noticed in the "Digest" July 9 Gross claims to have decomposed sulphur and to have obtained a new element which he calls bythium. The present author subjected the process described to a very careful and thorough examination. The process consists in passing an electric current through a fused mixture of chloride of silver and sulphide of silver; Gross claims to have obtained in this way an unknown body, which he considers to be a new element contained in sulphur. Alexander's results showed that all of the silver and sulphur in the original mixture were accounted for after the electrolysis; he therefore was enabled to verify the claim made by Gross.

PRODUCTION AND APPLICATION OF OZONE. Kershaw. Lond. "Elec. Rev.," Sept. 9.—A brief reply to the criticism of Andreoli (see "Digest" Aug. 27). He merely defends his original statements.

Units. Measurements and Instruments.

COMBINATION OF WESTON AND CLARK CELLS. Jaeger and Kahle. "Wied. Ann.," No. 8; abstracted in the Lond. "Elec.," Sept. 9.—If a Clark cell is reliable to within 0.001 volt and the Weston cell to within 0.0005 volt, it follows that the two cells combined may be depended upon to within 0.0001 volt; this they proved experimentally by comparisons with the standard silver voltameter of the Reichsanstalt. The latter is the ultimate legal standard in Germany, but as it is easier and better to determine a current from a voltage and a resistance than a voltage from a current and a resistance, the sooner the e. m. f. is made the standard the better. They tested sixty-eight cells constructed since 1891; they were tested at intervals of about a year, and the maximum difference observed in the Clark cell was —0.14 millivolt, and in the Weston + 0.18 millivolt, which, in two years, decreased to 0.08 millivolt. The cadmium cell should be used only between 20 and 70°. A large number of new measurements were made with these cells, and the redetermined values are as follows: H form of Clark cell, 1.4328 international volts at 15° C.; Weston cell, 1.0186 volts at 20° C.; the ratio of the Clark at 15° to the Weston at 20° is therefore 1.40663, and of the Clark at zero to the Weston at 20° is 1.42277, both figures being correct to at least the fourth place. The difference between the Clark at zero and the Clark at 15° is 0.0164 volts. The temperature coefficients are

Clark cell: $-0.00119\ (t-15)-0.000007\ (t-15)^2$.

Weston cell: $-0.000038\ (t-20)-0.00000065\ (t-20)^2$.

These figures give us two standards, the combination of which places the determination of the voltage very close in point of accuracy to the determination of the resistance.

METER. Moellinger. "Elek. Zeit.," Sept. 8.—A very long, illustrated description of the Raab meter for single-phase alternating currents, made by the Schuckert Company. After a brief introduction, in which he describes other similar meters, he gives a full description of this one. He claims that this meter was the first one which solved the problem of an induction meter, the indications of which are entirely independent of the phase-shifting in the current—that is, one in which the effect is recorded as in a wattmeter. This is accomplished by making the main current act together with two shunted currents, one of which, the inductive, is shifted in its phase by a very large amount, and the second, the inductionless, is shifted by a very small amount, as compared with the voltage; each of the two coils acts on a separate revolving disc, together with its own main current coil, the two discs being mechanically connected. For an incandescent lamp current the torque is produced almost entirely by the one coil, but if there is a phase shifting in the current, the torque in that coil would diminish very rapidly; in that case, however, the other coil increases its torque, thus assisting the torque produced by the first. When the phase shifting in the circuit is equal to that between these two coils, then only one of them will produce the total torque; if the two coils are properly proportioned the meter becomes an exact wattmeter for all phase shifting; this he shows analytically, after which he gives a full, well-illustrated description of the meter, showing also the method used in calibrating it, and giving the results of a test.

DOUBLE REGISTERING METER. "Zeit. f. Beleucht.," Aug. 20.—A brief, illustrated description of the one made by the Union Company. There are two registering portions, one of which is permanently connected with the motor, and is therefore always in operation when current is used; the second is connected to the motor only for the time during which a special rate is to be charged; the consumer can then read off at any time the total amount of energy and that for which a lower rate is to be charged; the necessary switching is accomplished by a clock.

DOUBLE READING METER.—"Elek. Anz.," Aug. 14.—A brief, illustrated description of one patented in Germany, in which the necessary switching arrangement is made by means of a contact disc driven by clockwork, which is rewound automatically every twenty-four hours; this switches into the circuit a compensating coil.

SHUNTING ELECTRO-DYNAMOMETERS. Wien. "Wied. Ann.," 63, p. 390; abstracted in "L'Eclairage Elec.," Aug. 20.—A long abstract of the article noticed in the "Digest" last week.

LEGAL STANDARDS IN GERMANY.—"L'Eclairage Elec.," Aug. 27.—A French translation of the laws concerning electrical units in Germany.

Telegraphy, Telephony and Signals.

WIRELESS TELEGRAPHY. Blondel. "L'Eclairage Elec.," Aug. 20.—A brief abstract of a French A. A. S. paper on the theory of the "antennæ" in this system of telegraphy. It is difficult to explain by simple effects of the ordinary propagation of waves the enormous increase of the distance by the use of these antennæ (meaning the terminal wires which Marconi uses). He attributes the effect chiefly to a phenomenon in which the capacity of the antennæ with respect to the earth enters; these antennæ and the earth are the two poles of a condenser. He shows how this theory enables the observed facts to be explained.

WIRELESS TELEGRAPH. Broca. "L'Eclairage Elec.," Aug. 20.—An abstract of a French A. A. S. paper. He explains the part taken by the "antennæ" (see above) in wireless telegraphy. These wires afford a means to produce radiant energy localized in a plane and therefore to concentrate the electric waves independently of their period. He also observed that these waves were polarized. Waves are obtained which are very effective at a great distance in one direction normal to the axis of the antennæ, and this involves no contradiction with the fundamental principles of the electromagnetic theory of light.

EXPERIMENTS WITH HERTZIAN TELEGRAPHY. Tietz. Lond. "Elec.," Sept. 9.—A long translation in abstract of the article noticed in the "Digest" Sept. 10.

TELEGRAPHY AND TELEPHONY IN NEW ZEALAND. Lond. "Elec.," Sept. 9.—A short editorial stating that since the reduction in the tariff from 25 to 12.5 cents there has been a large increase in the number of messages, but a larger increase in the expenditure; the balance of profits is in the right direction in the telephone service, but the growth in the telegraphs is distinctly on the losing side. It seems that when the telegraphs come under Government control there is a downward tendency, though in private hands they are flourishing enterprises; in New Zealand the postal department is a comfortable source of revenue, and the telegraph department a source of loss; it is not necessary that the telegraph should be carried on at a loss, and there are few who really believe that this is so; the post office at home (England) and abroad contrives to make it appear so, but nobody seems to know why.

TIMING TRUNK LINE SERVICE.—Lond. "Elec.," Sept. 9.—An editorial note stating that in London a large clock in view of all the operators is used for timing all messages; it is supplied with a large second hand which moves a quarter of a minute at a time. It is thought that clocks are used in other centres of that country and most continental exchanges; in Berne, however, there is a very primitive but efficient timer in use—namely, the sand glass; two sand glasses are provided for each trunk wire on the switchboard, a minute glass and a seconds glass; this system is as cheap as clocks, and more reliable, and is thought to be quite as useful as many of the more expensive methods.

NATIONAL TELEPHONE COMPANY.—Lond. "Elec.," Sept. 9.—A reprint of an article from the "Statist," the conclusions of which are that the soundest financial policy for the English Government to adopt would be to buy up the national telephone companies immediately at the market prices.

INTERCONNECTING TOLL-LINE SYSTEMS. Clausen. "West. Elec.," Sept. 17.—A short article giving a description of a complete toll-line system, showing the usual requirements that must be considered and provided for in equipping an extensive system.

Miscellaneous.

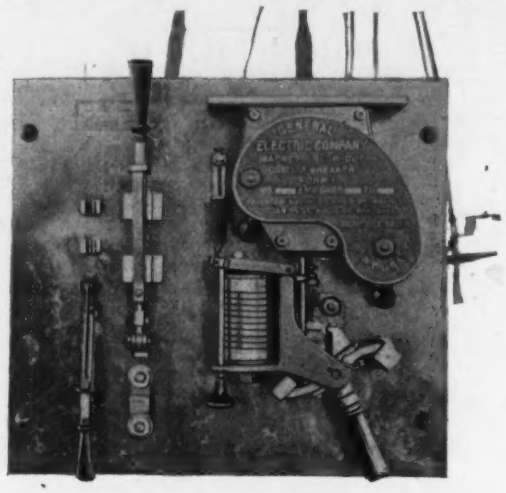
B. A. MEETING.—Lond. "Elec. Eng.," Sept. 9.—The programme of the meeting, with a list of the papers read. The presidential address by Crookes is noticed above. The address to the mathematical and physical section by Ayrton is published in full. After a brief introduction he discusses the subject of the physics of smell, giving the results of some interesting experiments in the form of a brief introduction to this subject, showing the vast territory that waits to be explored; it has no connection with the science of electricity.

ALUMINUM.—"Elek. Zeit.," Sept. 8.—A note showing the great reduction in the price of aluminum since it was first produced in 1855, when its price was about $200 per pound; in forty-six years the price per kilogram was reduced from $200 to 60 cents, and it is now 300 times less than it was in the year 1855.

EXPLORING FOR IRON ORE. Nordenstrom. "Eng. and Min. Jour.," Sept. 17.—A reprint in abstract of the article noticed in the "Digest" last week.

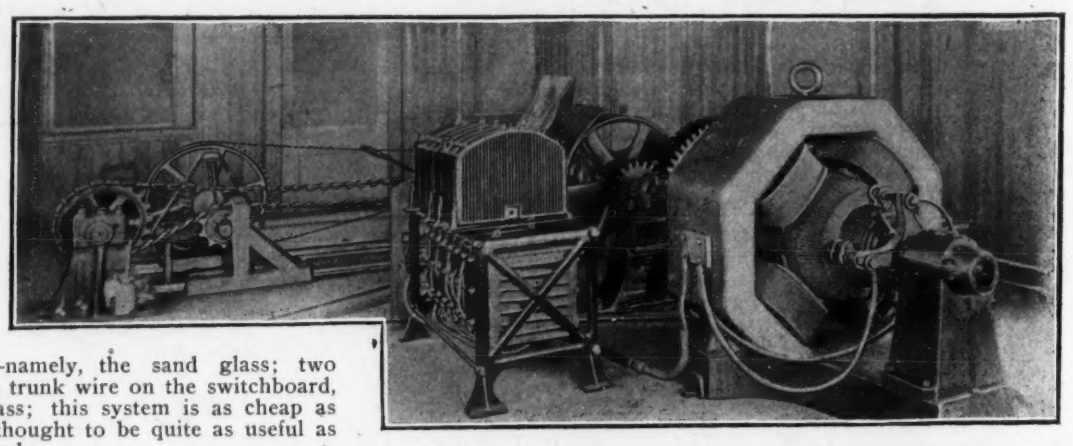
A Motor-Driven Swing Bridge.

An electrically operated swing span which presents some unusual modifications is that of the Jackson and Fourth Street bridge in Newark, N. J. The span of this bridge, weighing 450 tons, is turned by one 100-hp, 500-volt, direct-current motor, which also operates its latches and end-lifting wedges, the whole being fitted with a very complete system of interlocking mechanical and electrical controlling devices to prevent any serious effects from mistakes on the part of ignorant attendants.



THE SWITCHBOARD.

The bridge is supplied with current through the usual lead-covered and iron-armored feeder cables brought up to collecting rings surrounding the centre pin of the draw span. Two contacts bearing on these conduct the current to the motor when it is operating to turn the bridge, and a third or auxiliary contact on one ring is in circuit with the motor when it is used to operate the end wedges. This contact is arranged to be lifted by cams in such a way that the motor can only be run on the wedge-operating mechanism when the bridge is in the proper position for locking or unlocking. The motor is connected to the one commutator contact when swinging the bridge, and to the other when working the wedges, by means of a circuit-controlling mechanism mounted on the operating lever of a clutch which, when thrown in one position, connects the motor shaft to the bridge-swinging mechanism, and in the other direction to the wedge and latch-operating mechanism. Thus the two mechanisms can never be simultaneously operated. The motor is further controlled by an ordinary single-motor reversing street-railway controller. At all times it drives an air pump compressing air into receiver for whistle purposes. Further provision against harmful manipulation is provided by an attachment to the wedges which prevents the clutch lever being thrown over to the side in which the motor may operate the swinging mechanism unless the wedges are completely released. The current for the motor is taken from the 500-volt power circuit of the People's Light & Power Company, of Newark. The ingenious and novel features of the design are due to the constructing engineers, Messrs. Burhorn & Granger, of New York City.



THE MOTOR AND OPERATING MECHANISM.

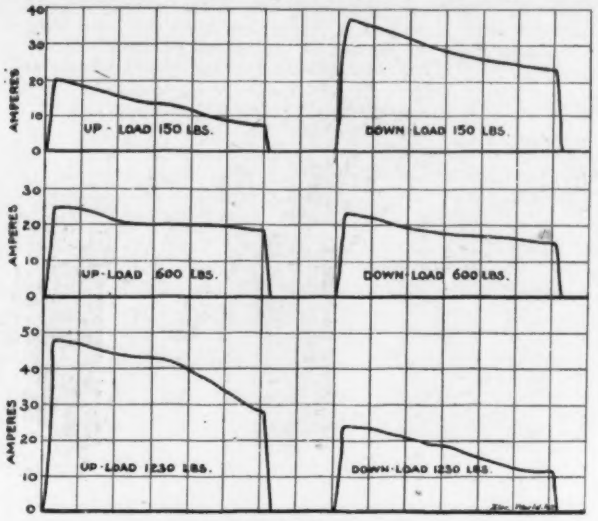
An Improved Elevator Motor.

The Keystone Electric Company, of Erie, Pa., has designed and placed on the market a new elevator motor, which is not only a remarkably efficient and serviceable device but comprises a distinct advance in motor design.

This machine, depicted in the accompanying cut, requires no external resistance whatever for regulating its speed and torque and hence the current it receives is all utilized in hoisting, a most important consideration when its owners are paying for current by meter. The torque per ampere is rendered very great by the use of an extra strong field when starting, and the current consumption is consequently further reduced. The company is prepared to

guarantee that the maximum current required to start and accelerate the elevator when hoisting more than one-half its rated capacity will not be over 25 per cent. more than that required to operate the same load at full speed.

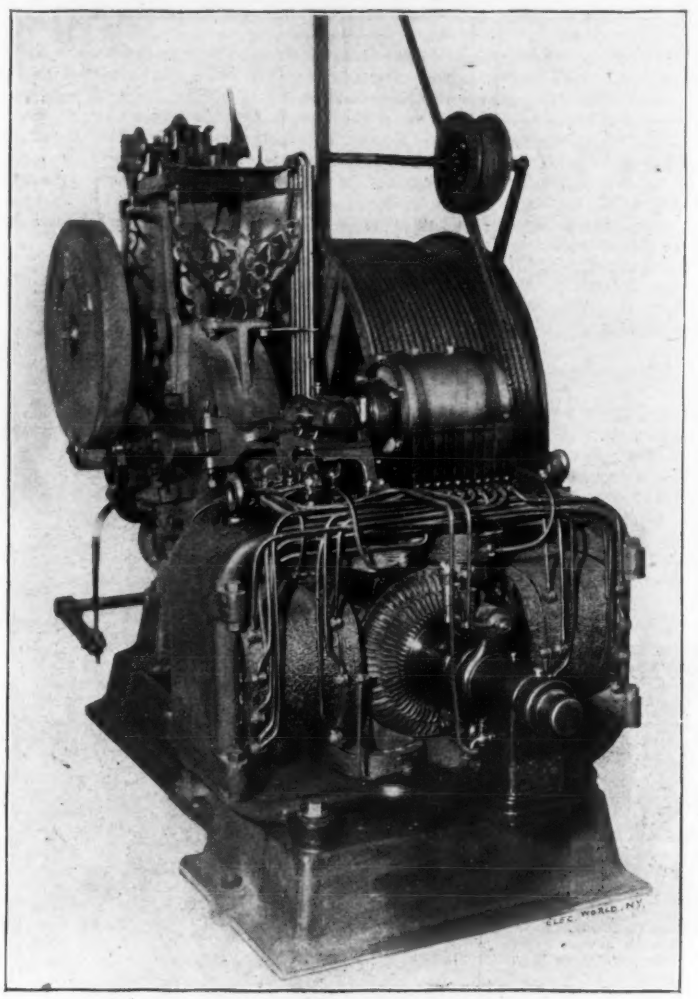
The regulation of the motor is accomplished entirely by varying the strength of its field, and consequently its back e. m. f. The field is wound for cumulative compounding, having an exceptionally powerful series coil. This coil is divided into numerous sections, and, as the load comes on, the sections are sucessively short-circuited until finally the machine is operating as a simple shunt motor. This varies the strength of the field and the back e. m. f. of



CURRENT CURVES.

the armature. This method of short-circuiting a series coil, in lieu of cutting out external resistance, as the speed increases has been attempted by many makers of motors, but has always been attended by severe sparking at the brushes, due to the weakening of the commutating fringe. The Keystone Class F machine is constructed to avoid this difficulty.

An inspection of the machine will show that although it is bipolar there are



ELEVATOR MOTOR AND MECHANISM.

six poles presented to the armature. The three poles on either side of a vertical plane, through the armature shaft, are of the same polarity; that is to say, there are three north poles on one side and three south poles on the other. The upper and lower pole pieces carry shunt windings only, while the central and larger pole cores carry both shunt and series winding, the shunt on the latter being only of sufficient strength to prevent magnetic short-circuiting in the absence of current in the series coils. It will be seen at once that the variation of the field is accomplished only in the central pole pieces, and that the field immediately adjacent to the gap in which commutation occurs is equally intense at all times. By this simple means the strength of the field can be widely varied and yet the brushes will always operate sparklessly.

This improvement in motor design was broadly covered by Mr. W. H. Powell in United States patent No. 608,771, issued August 9, 1898, and assigned to the Keystone Electric Company.

The sections of the series field are short circuited by the automatic movement of a cylindrical drum carrying suitable contacts shown immediately above the motor. The rapidity of the motion of this drum is controlled by a dash pot, and by the simple turning of a screw the rate of variation can be changed to suit any conditions that may arise. A reversing switch completes the electrical equipment.

It will be noted from the illustration that the field yoke is divisible. This is to provide that, if accident overtakes the machine, due to extreme carelessness or abuse, the trouble may be easily remedied. The horizontal coils can be disconnected and the pole swung outward by the removal of two bolts. By taking off the pole shoe the coil can readily be replaced.

A series motor for elevator work has the disadvantage that its speed varies between wide limits, and the desideratum in all elevator motors is constant speed. A shunt motor, on the other hand, while its speed is nearly constant, is objectionable because it requires an excessive current when starting. The cumulative-compound motor, pure and simple, also has a variable speed; moreover, both the series and cumulative motors tend to run away when the car is going down with a heavy load. This motor does away with these difficulties by the cutting out of its series coils, and retains the good qualities of both of the other types. It starts under full load easily and freely, without excessive current, and when once started maintains practically constant speed whatever the load.

The material and workmanship of this motor are of the very highest grade and the company has striven to make it second to none. The extreme simplicity of the apparatus should not lead the prospective purchaser to believe that it is suited only for small hoists or factory elevators; on the contrary the equipment is also exceptionally well fitted for high speed passenger service. This line of motors is made in sizes from 10 to 75 horse-power.

The company has had one of these elevator motors in successful operation in its own factory for over a year; and another of 5 horse-power in an apartment house in Cleveland operating an O'Donnell elevator. This motor has been in continuous service day and night for nearly a year, and is giving such unversal satisfaction that the Keystone Electric Company has received several orders for similar motors, to be installed in the same city.

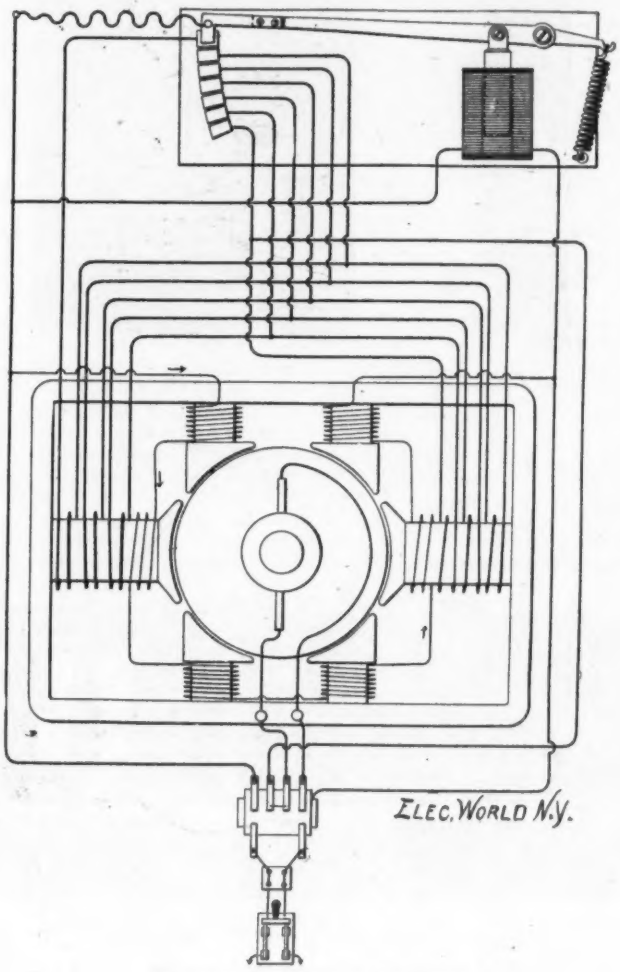


DIAGRAM OF MOTOR CIRCUITS.

The accompanying current curves were made from data obtained in a test which was made by the Cleveland Illuminating Company, in order to ascertain the maximum current required to start an overcounterweighted elevator driven by a 10-hp, 220-volt motor of this type under various loads. The high starting peak common in such work is conspicuous by its absence.

Ironclad Porcelain-Lined Resistance Box.

The most recent form of ironclad porcelain-lined resistance box, as manufactured by the Ward Leonard Electric Company, Bronxville, N. Y., is illustrated in Fig. 1. This box, which is made of cast iron, is about 14 inches square and about 2 inches deep, and is lined with the porcelain enamel of the Ward Leonard Electric Company. The inner face of the lid is also porcelain lined.

The resistance material is in the form of a very thin wide ribbon, reflexed edgewise and placed in the box, which is then filled with granular silica and

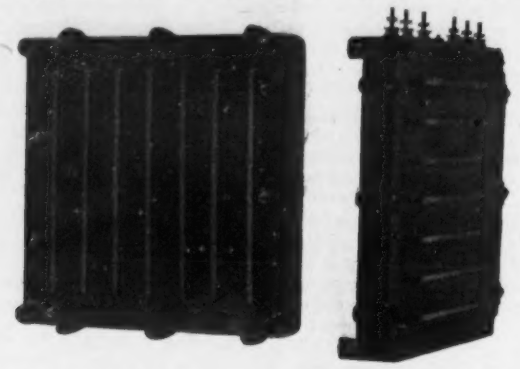


Fig. 1.—Ironclad Resistance Box, Porcelain Lined.

the lid firmly screwed down. A tight and permanent joint is made between the box and the lid by means of a special cement.

The box when finished weighs about 50 pounds, and its capacity for the absorption of heat developed in the resistance ribbon is extremely high. It is amply large for starting a 25-hp motor. This idea of using a large mass of material around the resistance for motor starting duty is covered by patent No. 566,693, issued to H. Ward Leonard. The construction used in this ironclad box having a ribbon-like conductor used in contact with the large mass of material is claimed to be a very superior and economical one. This feature is covered by United States Patent No. 560,588 to H. Ward Leonard.

One of the most important features of the ironclad resistance box is its

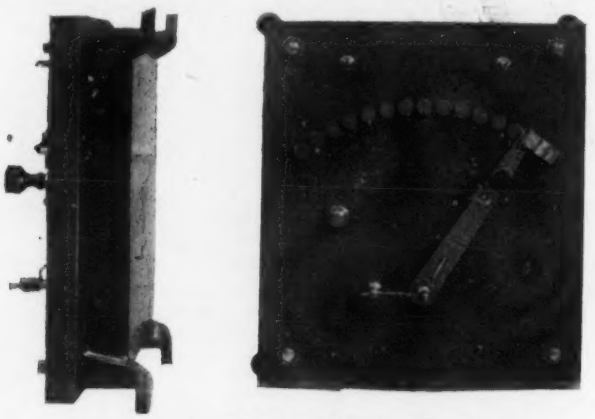


Fig. 3.—25-hp Motor-Starting Rheostat.

high insulation, due to the use of the porcelain enamel lining. This feature is covered by patent No. 603,063, issued to H. Ward Leonard.

Ironclad boxes of this type, the maker states, are being used with much satisfaction by such companies as the General Electric Company, the Westinghouse Company, the Crocker-Wheeler Electric Company, the C & C Electric Company, the Walker Company, the Bullock Electric Manufacturing Company and the Western Electric Company, and in the United States Navy.

In constructing resistance for large motors several of these boxes are con-

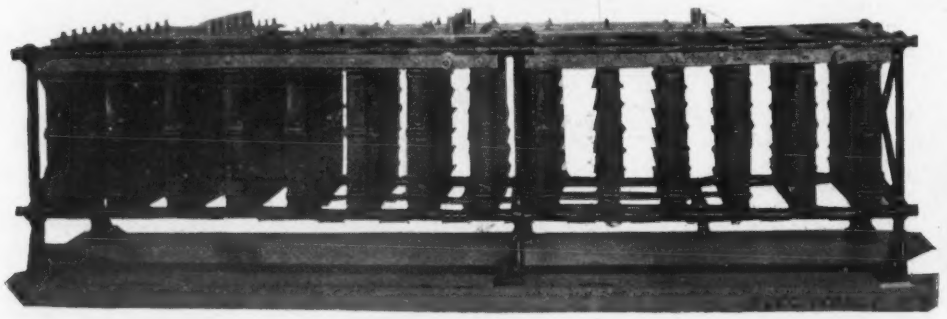


Fig. 2.—Bank of Resistance Boxes for 300-hp Motor.

nected in multiple, each being independent of the other. In this way a 100-hp motor would require four boxes, a 200-hp motor would require eight boxes, etc. A bank of these ironclad boxes used for 300-hp duty in connection with the electric locomotive of the Baltimore & Ohio Railroad Company is illustrated in Fig. 2. Fig. 3 represents a complete 25-hp starting rheostat having this type of resistance. These boxes have met with special favor for such service as elevators, traveling cranes, hoists, printing presses, etc., etc.

The resistance material used by the Ward Leonard Company is a special alloy of very high resistivity and low temperature coefficient and extremely high fusing point. The resistance, therefore, is entirely unaltered by the condition of service. This is of the greatest importance in the application of rheostats for such service as printing presses, elevators, etc.

Improved Form of Primary Battery.

The creeping of salts is one of the annoyances experienced in the use of primary batteries, to overcome which much time, labor and money have been expended, while the results have not always been altogether satisfactory.

Messrs. Meysenburg & Badt, 1504 Monadnock Block, Chicago, have met the problem in a very ingenious manner, as will be understood from what follows: The illustration, Fig. 1, shows the glass jar of the Badt hermetic cell, which is provided with a channel or trough around the upper edge of the neck, the cover, Figs. 2 and 3, having two glass rims, the inner one being concentric

Fig. 1.

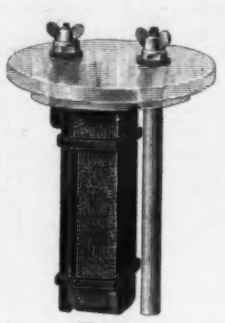


Fig. 2.

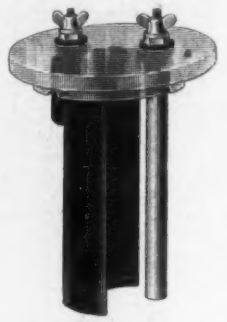


Fig. 3.

with the outer one. The inner rim of the cover rests in the trough, while the outer one surrounds the top of the jar and prevents dust from gaining entrance to the trough. The trough is filled with oil, thus furnishing an air-tight seal, which effectually prevents the creeping of salts. Another important advantage is the additional insulation from the jar and earth thus given to the electrodes, which are in turn insulated from each other by the glass of the cover. Figs. 2 and 3 represent electrodes for the No. 1 and No. 2 cells, respectively. In Fig. 2 the carbon has attached to it a prism (chemical depolarizer), while in Fig. 3 this feature is absent.

The Giant See-Saw at the Omaha Exposition.

An interesting application of electric power may be seen at the Omaha Exposition, where a giant see-saw is operated by an electric motor furnished by the Triumph Electric Company, Cincinnati, Ohio.

The supporting tower is an open steel structure, with four columns, two of its sides being triangular, and the other two rectangular in shape. The height of the pivot from the ground is 75 feet. Below the pivot is a platform containing the operating machinery. Attached to the swinging frame is a segmental gear, which is connected, through a compound gear, to a worm wheel on the platform below. The motor is of 10 horse-power, compound wound and

See-Saw Driven by Electric Power.

direct connected to the shaft of the driving worm wheel. It is of the reversible elevator type, manufactured by the Triumph Company, and is controlled by an elevator controller, operated by an attendant on the motor platform. The motor is wound for 500 volts direct current.

The see-saw, which is of truss construction of square section, is 200 feet long. At each end it carries a passenger car, from which at night a Rushmore searchlight is operated. These searchlights make an interesting feature of the night ascensions, as their rays are made to illuminate the surrounding country for miles.

NEWS OF THE WEEK

Financial Intelligence.

THE COMMERCIAL CABLE & TELEGRAPH COMPANY has certified to an increase of its capital stock from $100,000 to $500,000.

DIVIDENDS.—The Westinghouse Electric & Manufacturing Company has declared a dividend of 1¾ per cent. on its preferred stock, payable October 1. —The American Bell Telephone Company has declared its regular quarterly dividend of 3 per cent., payable October 15. This dividend makes 10½ per cent. declared so far this year, including one extra dividend of 1½ per cent. declared in June.

NEW YORK EDISON COMPANY'S EARNINGS.—The statement of earnings during August of the Edison Electric Illuminating Company, of New York, shows gross receipts of $202,516.26, an increase of $32,168.60, as compared with those of the corresponding month last year. The net earnings were $67,-692.06, an increase of $1,469.47. The increase in gross receipts for the eight months ended with August over those of the corresponding period of last year was $379,072.27, and the increase in net earnings for the same length of time was $122,480.52.

THE WESTINGHOUSE-WALKER CONSOLIDATION.—Mr. George Westinghouse on September 21 made the following announcement in behalf of his company relative to the absorption of the Walker Company by the Westinghouse Company: "The election this day of Roswell P. Flower and Anthony N. Brady as members of the Board of Directors of the Westinghouse Electric & Manufacturing Company to represent the interests of the former stockholders of the Walker Company completes the union of the interests of the Walker Company, of Cleveland, with those of the Westinghouse Electric & Manufacturing Company. The purchase by the Westinghouse Company includes substantially all of the outstanding stock and all but $850,000 of the $2,500,000 of the twenty-year bonds of the Walker Company, the $850,000 remaining a first lien upon the property. The recent sale of the Westinghouse Company of $3,000,000 of debenture certificates has erroneously been connected with this transaction. The entire proceeds of the sale of these debenture certificates were used in retiring the floating and other debt of the company, as previously announced. The increase in the total yearly fixed charges of the Westinghouse Company, due to the purchase of the Walker Company, will be but a little more than the sum that the Walker Company has been expending annually in defending patent litigation instituted by the General Electric and the Westinghouse companies. The acquisition of the Walker Company will, by reason of the agreement of March 31, 1896, between the General Electric and Westinghouse companies, put an end to this patent litigation and very large annual expenditure on both sides. The business of the Walker Company as a controlled company of the Westinghouse Company will be entitled to the protection of the patents of the Westinghouse and General Electric companies, and will, in all respects, be subject to the agreement between these two companies in relation to patents. The Westinghouse Company regards the business and good will of the Walker Company as a valuable acquisition, especially as the Walker Company brings upward of $1,250,000 of unfilled orders. The Walker Company has, in Cleveland, modern and extensive works, equipped with machinery capable of manufacturing the largest types of railway apparatus, and will, with the works of the Westinghouse Company, at East Pittsburg, constitute a manufacturing plant second to none in the country. The capacity and profits of the two companies will be increased by carefully harmonizing the manufacturing and selling operations, and the direct savings thereby effected should exceed the fixed charges incurred by the purchase of the Walker Company. The shipments of both companies, owing to the large orders on hand, have been increasing during the past few months and exceeded $750,000 for August. The total fixed charges of the Westinghouse Company, including those due to the Walker purchase, and the dividends on its preferred stock will be $42,000 per month."

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
9 Murray St., NEW YORK, September 26, 1898.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.—Secretary Pope has sent out notices of the next meeting of the institute, which will be held at the usual place, 12 West Thirty-first Street, this city, at 8 o'clock, Wednesday evening of this week. A paper will be read by Mr. Charles P. Matthews on the "Photometry of the Enclosed Alternating Arc."

EDUCATIONAL.—At this time of the year many young men who are engaged in business in the daytime are making their plans to study in evening schools. These are the young men who think, and think to a purpose, and are advanced in business by reason of their increased value to their employers. The Young Men's Christian Association conducts evening classes in commercial, scientific and language courses. At the West Side Branch of the association, 318 West Fifty-seventh Street, New York, the opening exercises of the educational classes will be held in the auditorium on October 3, at 8:15 P. M. Further information may be obtained of the secretary, Dr. D. E. Yarnell, 318 West Fifty-seventh Street, New York.

THE TELEPHONE COMMITTEE of the Merchants' and Manufacturers' Board of Trade of New York held a special meeting at the Hoffman House last Friday evening, and passed a resolution appointing a committee to attend the forthcoming Republican and Democratic State conventions for the purpose of securing in the platform of each party an avowal of the spirit of the resolution as expressed in its preamble. It is there charged that telephone companies in New York and other large cities discriminate against the small and in favor of the large subscribers. Such discrimination, the preamble avers, is unjust, illegal and contrary to the spirit of our laws as applied to similar corporations depending for their life and support upon the people.

EFFECT OF BROOKLYN TROLLEY COMPETITION ON THE LONG ISLAND RAILROAD.—The inroads that electric railways are making upon the passenger traffic of parallel steam roads in many places throughout the country is again exemplified, this time right at our own doors. The Long Island Railroad Company will on October 6 apply to the State Railroad Commission for authority to temporarily discontinue rapid transit stations on the Atlantic division of its railroad between Flatbush Avenue and Chestnut Street, Brooklyn. Decrease of traffic is the cause given as the reason for this application, the loss of business being due to the through service of existing electric street surface and elevated railway lines. The company is constructing a new connection with the Brooklyn Elevated Railroad Company at Flatbush and Atlantic Avenues. When this work is completed the company will restore the existing rapid transit facilities on the Atlantic division, which it is seeking to temporarily discontinue. If the Long Island Railroad could effecct an arrangement with the Brooklyn surface railways to secure trackage privileges and run its suburban trains by electric power through to the ferries and Bridge and New York it might hope to regain some of its lost business. A connection with the elevated railroad is only a partial solution of the problem. The thing for the Long Island road to do is to land its suburban passengers, and through passengers, too, if possible, at the point nearest to their destination without a break in the continuity of the trip, as the electric railways do. Electric equipment and traffic arrangements with existing surface lines seem to be the only salvation for the Long Island Company.

SOME NEW STREET RAILWAY ORDINANCES.—The surface and elevated railroads of this city are just now the subjects of special attention from the Municipal Assembly. Some of the resolutions introduced in that body during the past two weeks might be taken by many to indicate that a concerted attack upon these organizations from different quarters had for some reason or other been decided upon. Some of the conditions imposed upon the railway companies seem to be unnecessarily burdensome. About ten days ago some resolutions with especial reference to the elevated railways were introduced and referred to proper committees. On September 22 Assemblyman Christman introduced an ordinance compelling operating companies to keep their cars neat and clean; providing that signs indicating its destination shall be conspicuously displayed day and night on each car; that each surface car shall be provided with electric annunciators within the reach of every passenger; the abolition of shuttle trains or cars; that fares be refunded to passengers in case of obstruction on the line causing a delay of more than five minutes; that the steps of the surface cars shall be not more than 9½ inches from the ground, and fenders shall be used on all surface cars, with rollers actually touching the rails; that cars of all street railway companies shall be heated whenever the thermometer shall fall below 55 degrees Fahr.; that all cars shall be sufficiently well lighted to enable passengers to read with comfort; that in case of accident, cars shall not proceed on their routes, but shall remain at the place where the accident occurred until the arrival of the police and until released by proper authority; that the penalty for the infraction of each and every one of the foregoing sections shall be $100 for each trip. The ordinance was referred to the Railroad Committee.

AS TO ELECTRICITY ON THE ELEVATED ROADS.—Every once in a while a report is given currency to the effect that the Manhattan Elevated Railway Company contemplates the adoption of electric power on its lines. There have been so many rumors of this character in the past couple of years and so much talk and speculation in connection with the same, with no tangible results, that the people have about come to the conclusion that the company does not intend to nor ever has intended to do anything of the sort. The need for improved and more rapid transportation in our long city streets is a pressing and immediate one, which the "going-to" policy of the Elevated Railway Company does not in the least satisfy. The latest report about electric power on the elevated road is somewhat refreshing in that it differs somewhat from its many predecessors. Coming from a director of the company it may reasonably be regarded as reflecting the sentiment of other members of the board, if not the majority. After all the hopes that have been held out to the suffering public this gentleman states that it has "not yet been demonstrated that electricity will be either a safe or an available power for Manhattan." If the directors of the Metropolitan Street Railway Company entertained a similar view with respect to that company's lines the people of New York would be justified in rising up in their might and demanding what they are entitled to at the hand of the transportation companies in return for the privileges enjoyed by the latter. The enterprise of the Metropolitan Company and the resulting splendid service is, however, fully appreciated by the people, as is evidenced by their liberal patronage of the same. People prefer to take a surface car rather than climb two or three or more flights of stairs, if the street car can take them to the point nearest their destination within a reasonable time. The result upon the elevated railway traffic of the improved surface traction is very marked. The elevated trains are not so numerous as they were a year ago, and the number of cars per train has been reduced. This is striking evidence

on the one hand that people appreciate what is being done for them by the surface railways; on the other hand it is a rebuke to the inaction and indifference of the elevated railway people. The fact that the tide of nickels is turned in favor of the surface cars is proof of this. Circumstantial evidence seems to be accumulating that something quite out of the ordinary is pending in Manhattan Elevated affairs. There are, in fact, intimations that a new corporation is to be formed to undertake the electrical equipment and operating of the Manhattan Elevated Railway, and so, perhaps, facilitating an operating alliance with the Metropolitan Street Railway. It is even said that the papers for this new corporation have been drawn, and that its title is to be the New York Railway Company.

Buffalo and Niagara Falls Notes.

Buffalo, N. Y., September 21, 1898.

SLOW DEVELOPMENT of the demand for Niagara electric power seems to be inevitable under the circumstances. The two industries here, grain elevating and flour milling, which were expected to lead the demand for power, are earning less money than they should, and are very conservative. Some of the solicitors for business are preparing to depart for other fields temporarily.

THE GENERAL ELECTRIC COMPANY has obtained the contract for furnishing the Buffalo General Electric Company with about 60,000 feet of cable to go into the new subways in the city. The cost will be about $39,000 and about ten sizes will be used. The company expects to have it all in before winter. The cables just put in by the Standard Underground Cable Company are paper insulated, but the new contract calls for rubber insulation.

THE SCHOELLKOPF HYDRAULIC CANAL COMPANY, at Niagara Falls, has completed the line for connecting the power house in the gorge with the new factory for the production of chlorate of potash, and the plant is now running satisfactorily. This canal company has about 14,000 horse-power available. It supplies the Gorge and Youngstown trolley lines with power and the city with light, and has about twenty factories, large and small, on its list that receive power and light regularly. So far the management has not made any effort to obtain business from distant towns, though it may do so when the demand at home reaches its limit.

St. Louis Notes.

St. Louis, Mo., September 22, 1898.

THE ELECTRIC CONNECTING RAILWAY COMPANY filed articles of incorporation last week. The capital stock is $2000. John H. Bobring, M. T. Chestnut and James D. Houseman are stockholders. The corporation intends to operate a street railroad.

STREET CARS FOR JAPAN.— A St. Louis car company has received an order from Japan for 250 street cars. They will cost $300,000, and are to be delivered within ninety days. This is the first order of this kind from Japan. St. Louis has been furnishing Mexico with street cars for some time.

TROLLEY LINE TO DE SOTO.—The United Traction Company of St. Louis will build an extension of either the Tower Grove or Carondelet lines from the southern limits of the city into Jefferson County to De Soto. The company's plans cannot be definitely known until the Messrs. Scullin return from Europe and the East, but it is understood that the line is to be built before cold weather sets in.

THE FOURTH STREET AND ARSENAL RAILROAD was sold last Tuesday to John H. Overall, attorney for the Central Traction Company, for $191,000 cash. It is generally conceded that Mr. Overall represents the Central Traction Company, though some think he bought in the interests of the bondholders. The bonded indebtedness is represented by $150,000 of first mortgage bonds and $100,000 of seconds. The capital is $300,000. The figure paid for the road is a large one, and has caused much interest in financial circles.

Canadian Notes.

Ottawa, Ont., September 23, 1898.

THE PETERBORO, ONT., LIGHT & POWER COMPANY is about to commence the erection of a large water-power station. The new station will cost between $30,000 and $40,000, and the company expects to develop about 2000 horse-power.

THE MUNICIPAL OWNERSHIP IDEA has apparently not swept the city of Hamilton, Ont., for a proposal to purchase the street railway there has been rejected by the ratepayers of the city by a vote of 264 to 2043. Hamilton has at present an arrangement with its street railway that yields the city $16,000 per annum.

AT THE MONTREAL ROYAL ELECTRIC COMPANY'S annual meeting the reports presented were considered to be satisfactory. The gross revenue was shown to have been $955,826; expenditure, $636,057, interest and fixed charges, $42,609; net profit, $277,160. Four quarterly dividends have been declared of 2 per cent. each, equalling $120,000. Ninety thousand dollars were charged to profit and loss for reduction of assets in patents; $25,000 for the depreciation of plant, and $31,992 for other reasons. It was shown that the company last year made 18½ per cent. on invested capital. A dividend of 8 per cent. has been paid yearly since 1891.

THE HEARING of evidence in the big electrical fight between the Royal Electric Company and the Lachine Rapids Hydraulic Company is now being taken before Judge Taschereau, at Montreal, and promises to last some time. The Royal Electric started the ball rolling by first taking out an action for $5000 against the Lachine Company for general injury to its business by interfering with its circuit, by crossing of wires and cutting same, erection of poles, etc. This original demand was supplemented by an incidental demand of $50,000 for additional and sustained damages. The Lachine Company took out a counter action for $105,000 damages to its business, and for the circulation of injurious rumors that the Lachine Company was suffering from the ice and that it would be unable to carry out its contracts, and other injurious stories. These rumors, it is claimed, were of a nature to discredit and injure the company in the eyes of the community.

French Notes.

(From Our Own Correspondent.)

Paris, September 2, 1898.

THE ELECTRICAL TRANSPORTATION COMPANY AT THE EXPOSITION.—This company has been incorporated with a capital of 2,000,000 francs, divided into 20,000 shares, par value 100, all subscribed for and with one-fourth of the capital paid in. The object is to carry on the business of the Intramural Railway at the exposition, according to the plans elaborated by M. de Macomble. Provision has been made for increasing the capital.

THE EXPOSITION OF 1900.—At the last meeting of the Committee on Electricity for the Exposition of 1900 M. Picon, chief engineer of electrical works, read a report on the installation and operation of the generating machinery for 1900. It has been decided that exhibitors may furnish the exposition with electrical energy. They are to submit plans for the approval of the exposition administration. They will do their own erecting. Each machine, whether alternating or direct, will be direct connected to its engine, and will be furnished with a special switchboard. All transformers needed are to be furnished by the exhibitors. The period during which electrical energy must be furnished will cover about 205 days; from April 15 to November 5, 1900. A rotational service will be arranged so that the hours of work will not exceed seven per day. The exhibitors who furnish electrical energy will be paid a compensation for the expenses of installation and operation.

ELECTRIC LIGHT FOR THE BOIS DE BOULOGNE IN PARIS.—In accordance with the public wish, which has been expressed for some time, the authorities have decided to install electric light in the Bois de Boulogne. It will, of course, be possible to light only the chief avenues, which will leave plenty of corners for those who like to prowl in the dark, and for others. The plans are ready; they were prepared under M. Bareaux, Director of Parks and Public Grounds. The completed plan includes the lighting of the long avenue running from the Maillot Gate to the Suresnes Bridge, through Longchamps, with two pathways from Longchamps to the end of the ponds and to the Dauphine gate; the lighting of the drives around the ponds and the lawns of La Muette; and also the Avenue de l'Hippodrome, running from the ponds to the hippodrome of Longchamps, together with a part of the Queen Marguerite Road, lying between the Longchamps Road and the Avenue to the Hippodrome. These three divisions constitute three "pressing needs," which can all be done at once or one after the other. The lighting will be done by candelabra supporting very powerful arc lamps, after the manner of those on the Paris boulevards. Current will be furnished either by a municipal power station built for the purpose, or else by the central station at Puteaux. The cost of construction, including the conduits, the erection of supports for the lamps and the lamps themselves, will come to about 435,000 francs, being divided as follows: 205,000 francs for the first division, 140,000 francs for the second and 90,000 francs for the third. The execution of this project is, of course, subject to the approval of the Municipal Council, which meets in October, and which will vote the necessary money, if after due discussion the conclusion is reached that the proposed work is desirable. It is quite probable, however, that the measure will be passed, although not without opposition. For while there are many in favor of it, there are also some dissenting voices heard. Those in favor of the scheme, and among these are the cyclists (the cyclist press having maintained a very vigorous campaign in favor of it), point to the advantage of having the light to help in clearing the park of the bad characters that now infest it. Hidden in the shadow of the bushes and the underbrush, where the police cannot reach them, these people watch for a chance to attack with a club or a knife some unsuspecting person who may happen to venture beyond the Chinese Pavilion. Or they will stretch a string between two trees across an avenue, so as to throw some cyclist, who is then knocked on the head for the sake of getting his machine. With the avenues lighted other inhabitants of Paris, as well as the cyclists, can go and breathe a whiff of fresh air in the evening, a thing which will soon be brought within the reach of all, since the new tram line from Porte Maillot to Suresnes, which skirts the sunken fences of the park, will enable those who possess neither horses nor carriages to ride at small expense. The lighting of the park is therefore a democratic measure, and that is a reason which will insure its approval by the Municipal Council.

MEETING OF THE FRENCH SOCIETY OF CIVIL ENGINEERS.—1st. M. R. Soreau, in a paper entitled "Steam, Oil and Electricity for Automobiles," takes up the following questions: A. How do the advantages and disadvantages of the various methods for producing power compare with one another when considered with reference to their application to automobile carriages? B. What improvements may be reasonably expected to take place from now on? Without in any way attempting to formulate rigorous answers to these questions (which would be a rather foolish thing to do considering the state already attained by an industry which is scarcely fifteen years old), M. Soreau takes up the problem in a general way, from the two points of view so aptly termed by Mr. Clarke the anatomy and physiology of motors. He presents some information on Serpollet's new generator; he dwells on the different phases of the cycle of petroleum motors, he shows how it happened that M. Diesel was led to design his remarkable device which trebles the thermal efficiency; lastly, he takes up the electric motor and analyzes the chief results and facts brought out by the recent cab competition. 2d. M. F. Drouin makes a report on electrical traction by means of quick charging accumulators. He describes the system of traction in use in the lines of the Madeleine in Paris. This plant, which was put in in 1896 by the Industrial Electrical Motor Company, differs from methods hitherto employed, in that the charging takes place extremely rapidly at the end of the line while the car is standing. Before proceeding to describe the details of the system, M. Drouin speaks of the mixed method employing both trolley and battery systems which led to the invention of rapid charge accumulators. A series of comparative tests conducted by Mr. Ross has shown the system to give good results and to be satisfactory. The street cars in Hanover, Dresden, Berlin, etc., make use of the mixed system. It was not possible to apply this form of traction to the Madeleine lines, since the authorities will not sanction the use of the overhead trolley in this district. On the other hand the use of movable batteries would not do because it would have required three charging stations to handle the batteries. The system hit upon was to use batteries which admit of being charged in the cars

during the short stop which the latter makes at the terminal station. The severe treatment to which the accumulators are subjected under such a rapid rate of charge necessitates an unusual arrangement, which is attained in the case of the Tudor battery as follows: A. By the use of plates having enormous surface. B. Charge at constant voltage and by working the battery below its maximum capacity. The cars weigh 13.7 tons, of which 7900 pounds are due to the accumulators. The battery has 200 cells stowed under the seats. A small switchboard is provided for connecting the battery either to the charging or to the discharging circuit. Flexible cables are used to connect the car with a charging box, in which are the terminals of the underground feeders that connect with the power station. The charging pressure is 600 volts. The power station is located on the Quai National, at Puteaux, and has three groups of generating machinery of 120 kilowatts each. After showing slides of the cars and power house and detailing some of the results of the experience acquired during the operation of these lines M. Drouin concluded his paper with a description of some experiments that were made to determine the frictional resistance to tractive effort for these cars. On a straight, level track this frictional resistance, including the motor when turning dead, and for speeds lying between 5 and 25 kilometres per hour, is given by the formula

$$R = 3 + .16\,v,$$

where R is expressed in kilogrammes per ton and v in kilometres per hour. For the car alone without the motor the formula is:

$$R' = .94\,R.$$

Experiments were also made on curves. The results differed widely, according to the state of the rail, and the amount of inclination, etc. At a speed of 10 kilometres per hour on a curve of 40 to 50 metres radius the force required reaches about 25 kilogrammes per ton. On a curve without any inclination the frictional resistance increases rapidly with the increase of speed.

General News.

THE TELEGRAPH AND TELEPHONE.

BOSTON, MASS.—The Erie Telegraph & Telephone Company added 756 subscribers to its system during the month of August. The total number connected September 1 was 27,677.

LOUISVILLE, KY.—The Monticello & Jamestown Telephone Company has been incorporated with the capital stock fixed at $3000. The incorporators are J. B. Patterson, W. W. Jones and W. F. Rowe.

LEWISTON, PA.—The Huntingdon County Telephone Company has been chartered. It has $25,000 capital, with offices at Saltillo. C. Kapp, John Kapp, G. Sleeman, Frank Harkleroad and Henry Taylor are directors.

CLEVELAND, OHIO.—The Cuyahoga Telephone Company, Cleveland, has been incorporated, with a capital of $3,000,000, to build telephone and telegraph lines in Ohio. The incorporators are E. W. Moore, J. B. Hanna, J. B. Hoge, H. Clark Ford, John Sherwin, H. A. Everett and H. B. McGrew.

CHEYENNE, WYO.—The North Park Telephone Company has filed articles of incorporation. The company will erect and maintain a telephone line from Walden, Col., to Laramie City, Wyo. The capital stock is $15,000. The stockholders are Monte Blevins, J. O. Mosman, George F. Scott, C. E. Mosman and M. C. Ward.

MORAVIA, IA.—The Moravia telephone line has been sold to the Ottumwa Long Distance Telephone Company. The line purchased connects the towns of Moravia, Albia and Blakesburg. It is the intention of the purchasers to extend the service to Ottumwa, Centreville, Moulton and Bloomfield, Ia., and to several important points in Missouri.

JANESVILLE, WIS.—The Wisconsin Telephone Company has completed its long distance metallic circuit from this city through Monroe to Gratiot, and will extend it through Shullsburg, Darlington, Platteville, Lancaster, Fenimore and other villages to Dubuque. This will place Janesville in metallic telephone connection with all Southwestern Wisconsin.

NOBLESVILLE, IND.—The County Commissioners of Hamilton County have granted the right of way to the New Long Distance Telephone Company of Indiana over the roads and highways of Hamilton County for its poles and wires. There is much interest in this city in the independent telephone movement. The New Long Distance Telephone Company will connect with the exchange of the Noblesville Telephone Company, which is a prosperous and successful institution of this city. A line from here to Indianapolis will be ready for immediate use upon the completion of the New Company's plant at Indianapolis.

ELECTRIC LIGHT AND POWER.

OCALA, FLA.—The Council is arranging to make extensive improvements to the electric plant.

HAVANA, CUBA.—The electric plant at Cardenas has suspended public lighting, the municipality being in debt $300,000 to the concern.

CHARLOTTE, N. Y.—The Stanwix Engineering Company, of Rome, is preparing plans for a light and water plant to be erected at Charlotte.

SHELBINA, MO.—The city of Shelbina, Mo., has awarded its order for one 2000-light alternator and one 200-hp. Hamilton-Corliss engine to the Royal Electric Company, of Peoria.

CLEVELAND, OHIO.—The Fanner Manufacturing Company, 1521 Pearl Street, will build a factory, which will be equipped with its own electric plant. Contracts are not yet let.

NEWTON, ILL.—The electric light plant at this place was started on September 16. A 60-kw alternator, bought by the city from the Royal Electric Company, furnishes the light.

TRENTON, N. J.—Chancellor McGill has filed an opinion deciding that a receiver should be appointed for the Franklin Electric Light Company of Cape May. The application was made by the Fort Wayne Electric Corporation, a judgment creditor.

PITTSBURG, TEX.—J. A. McFinney, of this place, has placed an order with the Royal Electric Company, of Peoria, for a 40-kw alternator for the electric light plant he is erecting.

KALAMAZOO, MICH.—The Kalamazoo Valley Electric Company has been organized with a capital of $100,000, to develop the water power of the Kalamazoo River near Allegan and distribute electric current to the towns within a radius of several miles.

SEABRIGHT, N. J.—The Seabright Electric Light Company's power house caught fire on the night of September 14, and was totally destroyed. The town was consequently in darkness. The building was erected last spring at a cost of $12,000, and was insured for $8000. The light supply to the hotels and seaside cottages was shut off.

PITTSBURG, PA.—Arrangements are now being made by the officials of the Pennsylvania Tube Works Company for the installation of a complete electric plant in its works on Second Avenue to cost $100,000, and the operation of the entire plant by electricity. This will be the first large iron mill in the United States to adopt electricity for power. It has been calculated that an immense saving will be made in the use of the new power. It is the intention of the tube company to erect one central power plant of about 1000 horsepower, and distribute the electricity through the lap and butt weld departments to about twenty-five motors, of 40 horse-power each, that will be placed near the various machines. This installation will do away with a large number of engines and the labyrinth of steam pipes that causes such annoyance in a great mill. The plant will be located near the river, where the coal supply of the company is received, and boilers capable of producing about 750 horsepower will be added to the present battery. It is believed by electrical experts that many changes will be made in the next few years by the steel mills, for all have been making money and can afford to pay for the alterations.

THE ELECTRIC RAILWAY.

CLEVELAND, OHIO.—The directors of the Cleveland Electric Railway have declared a quarterly dividend of 1 per cent., payable in October.

MONTREAL, QUEBEC.—On September 16 fire destroyed the car sheds of the Montreal Street Railway Company, entailing a loss estimated at $100,000.

BENNINGTON, VT.—A small cyclone passed over this town recently wrecking the power station of the Bennington & Hoosic Valley Electric Railroad and causing a damage estimated at $3500.

BROOKLYN, N. Y.—It is stated that the work of equipping the Fifth Avenue and Lexington Avenue branches of the Brooklyn Elevated Railroad with electricity will begin on October 15. The change will involve an expenditure of $750,000.

COLORADO SPRINGS, COL.—It is reported that the owners of the Cog Road running up Pike's Peak have decided to change the motive power from steam to electricity. It is estimated that the cost of making the change will be about $50,000.

NEW YORK, N. Y.—President Guggenheimer of the Council is preparing an ordinance to compel street car companies to place the steps on their cars not higher than 9 inches from the street, and to compel the cars to stop when a passenger signals.

MUNCIE, IND.—The County Commissioners have granted Indianapolis and Chicago capitalists a franchise for an electric railway line from Albany, this county, to Camden, Jay County, via Dunkirk. Albany has granted the projectors an indefinite franchise.

COHOES, N. Y.—It is understood that the State Railroad Commission will refuse to grant the Waterford, Mechanicville & Stillwater Electric Railway Company permission to cross the D. & H. tracks at North Third Street, Waterford, at grade. This decision, it is said, has been arrived at since the Cohoes railroad disaster.

HANNIBAL, MO.—The Hannibal street railroad, recently bought by the Farmers' and Merchants' Bank of this city, has been sold to a Philadelphia syndicate for $17,000. It originally cost $75,000. The new owners announce that they will spend $150,000 on improvements, including an extension of the line to Mt. Olive Cemetery.

SAN FRANCISCO CAL.—The Bakerfield & Los Angeles Railway Company has been incorporated by Claus Spreckels, John D. Spreckels, A. B. Spreckels, Robert Watt and A. H. Payson, to build a railroad from Bakersfield over the Tejon pass to Los Angeles, 200 miles. It will connect with the Southern California Railway, a branch of the Santa Fé, running from Mojave to Los Angeles.

PHILADELPHIA, PA.—John Lowber Welsh has resigned the presidency of the Union Traction Company, the corporation that controls all the street car lines in this city. It is believed his successor will be George W. Elkins, a son of William L. Elkins, one of the principal stockholders of the company. The directors at a meeting on September 19 decided upon an assessment of $5 a share upon all stockholders, making $17.50 paid in on a par value of $50.

DURAND, MICH.—The Long Lake, Durand & Corunna Railway Company has asked the Vernon Township Board for a franchise. Vernon City, Durand and Fenton have granted franchises, and the Durand one has been accepted by the company. As soon as the matter is settled in Vernon township bids for the construction of the road will be called for. Work will commence January 1, 1899, and the road will begin operations in the spring. It will run from Fenton to Corunna.

PETERSBURG, VA.—The Hustings Court has entered an order in the suit of the Upper Appomattox Company against the Petersburg Electric Railway Company and the Farmers' Loan & Trust Company against the same, ordering a sale of the road to be made on Thursday, the 10th day of Novem-

ber next, in order to pay off the liens which have been secured against the company and the bonds amounting to some $50,000, which were secured by deed of trust upon the property.

WILMINGTON, DEL.—The Wilmington City Electric Company is making many and extensive improvements to its plant on Fifth Street. A storage battery of 2000 ampere-hours' capacity will be installed and will be so designed that it can be increased to nearly double capacity at some future date. The present boilers will be torn out, and one 600-hp Morrin Climax boiler will be installed. The engine plant will also be improved by compounding the engines and making them direct connected with the dynamos.

CHICAGO, ILL.—The statement that the South Side Alley "L" has passed under the control of the Chicago City Railway Company lacks official confirmation. A prominent official of the elevated company makes the statement that he has no knowledge whatever of any such deal, and that, furthermore, it has not been a subject of discussion at any directors' meeting. It is unofficially stated that by the deal the Alley "L" is absorbed by the surface line, the latter assuming $750,000 outstanding bonds and guaranteeing 4 per cent. on the $10,328,800 of capital stock of the elevated road.

NEW YORK, N. Y.—The Safety Third Rail Electric Company was incorporated at Albany during the past week. The capital of the company is $1,000,000, and the incorporators are Emerson McMillin, Sr., Emerson McMillin, Jr., W. F. Douthirt, C. F. Scoville, William M. Keepers, R. H. Beach, David F. Halstead, J. McLeod Murphy and Louis Steckler. Mr. Murphy states that a public test of the system will be made at once over the short line at Manhattan Beach, owned by the Manhattan Beach Land Improvement Company, and running between the Manhattan Beach and Oriental hotels. It is expected that the test will be made in sixty days.

YONKERS, N. Y.—It is said that the Union Railway Company, which is now in control of the local lines, is paving the way for a franchise to build a big bridge connecting Mt. Vernon and Yonkers over which to run its cars. The company was met, it is declared, with a flat refusal from the Hudson River Railroad people for a permit to cross the Harlem Railroad tracks at the present terminus of the Yonkers Avenue line. The proposed bridge would be the only means of crossing the tracks, and this would necessitate a franchise from both the cities of Yonkers and Mt. Vernon, as the bridge would probably extend from Sherwood Park in Yonkers to the top of what is known as Bocks Hill in Mt. Vernon.

Educational Notes.

THE INTERNATIONAL CORRESPONDENCE SCHOOLS, Scranton, Pa., have added to their courses of instruction one in telephony. Mr. Kempster B. Miller, the well-known telephone expert, is the instructor in this course. The schools have just issued a pamphlet giving a brief synopsis of the course in telephony, and judging from its contents the subject has been most completely covered.

THE BROOKLYN INSTITUTE OF ARTS AND SCIENCES has just issued its prospectus for 1898-99. It is a book of 168 pages, and contains a preliminary announcement of the anniversary meetings, addresses, lectures, exhibitions, department meetings, concerts, dramatic readings, schools, courses of instruction and the other work which will be conducted by the institute and its departments during the year 1898-99. The season begins on September 29, 1898, and closes on June 3, 1899. In the department of electricity regular meetings will be held on the first Friday evening of each month, commencing with October 7. Eight illustrated lectures on current topics of interest in electricity have been arranged for the season, and additional lectures will be given from time to time on subjects of special and current interest.

Legal Notes.

THE ELECTRIC STORAGE BATTERY COMPANY, through its attorneys, A. B. Stouten, of Philadelphia, and F. P. Fish, of New York, has filed in the United States Court a petition asking that an injunction be granted restraining the Wilmington City Electric Company, Wilmington, Del., from putting in its proposed storage battery plant. The complainant alleges that the local company has made and constructed and threatens to use secondary batteries and secondary battery elements which are an infringement on patents the Electric Storage Battery Company holds, having purchased them from Charles F. Brush, the inventor. Judge Bradford granted an order compelling the Wilmington City Electric Company to come into court on October 12 and show cause why a temporary injunction should not be granted.

THE HORN & BRANNEN MANUFACTURING COMPANY, of Philadelphia, has appealed from the decision against it in the United States District Court in the suit brought by the owners of the Steiringer electric fixture patent. The lower court had granted a preliminary injunction, and this appeal was to set that aside. The case involves the right to the use of an insulating joint used to support the fixture. The defense set up that its joint was not the same as that of the patent, and its pleadings charged that the suit was brought in the interest of a New York fixture trust, who were endeavoring to control the trade. It also alleged that the present case was an invalid reissue of an old patent, which had previously been defeated several years ago in a suit against the Gibson Gas Fixture Works. The plaintiffs were represented by R. N. Dyer, of New York, and F. P. Fish, of Boston, while the Horn & Brannen Company was represented by Hector T. Fenton and by ex-Justicec Samuel Gustine Thompson of Philadelphia. The court took the case under advisement and reserved its decision.

Personal Notes.

MR. CHARLES P. BRUCH has been appointed assistant general manager of the Postal Telegraph-Cable Company, New York. He will retain his former position as assistant secretary.

MR. WILLIAM HAND BROWNE, formerly of the department of steam and electrical engineering. University of Nebraska, has been appointed professor of electrical engineering at the University of Illinois, Champaign, Ill.

CAPT. F. S. DE RONDE, of the Standard Paint Company, New York, is lying dangerously ill at his home in Englewood, N. J., with typhoid fever. Mr. De Ronde is captain of Company F, Second New Jersey Volunteers, and returned home a few days ago from camp. His many friends hope for his early and rapid restoration to health.

MR. H. BEVIS, manager of the General Electric Company, Ltd., of England, is in this country for a brief business visit. Mr. Bevis is arranging for the handling on this side of the Atlantic of some of the General Electric Company's well-known specialties, including the "Hunningscone-Deckert" microphone, and the Aron electric meter, recently approved by the British Board of Trade. His address is the Hotel Imperial, New York.

MR. S. JEVONS, director of the Gem Dynamo Brush Company, of Birmingham, England, is in America for a short time to arrange for the manufacture and sale in this country of the "Sparkless Gem" wire gauze brush. The sale of this brush in Europe has been very large, owing to the excellent satisfaction it has given to users, and there is believed to be an extensive field for it in the United States and Canada. Mr. Jevons is at the Westminster Hotel, New York, where he may be addressed. He will be glad to call upon or communicate with anyone interested in the "Gem" brush.

MR. F. E. PETTINGELL, who on account of illness was compelled to sever his connection with the Pettingell-Andrews Company, of Boston, several years ago, has now fully regained his health, and states that he expects soon to re-enter the electrical field. Mr. Pettingell has a very large acquaintance in the trade, and any manufacturer who secures his services will be very fortunate, as Mr. Pettingell's acquaintance, to say nothing of his ability as a salesman, is of the greatest value. The Electrical World wishes him success and a continuance of his regained health. Mr. Pettingell is at present residing at 16 West Twenty-seventh Street, New York City.

Obituary Note.

MR. WILLIAM T. RYLE, president of the Edison Electric Illuminating Company, of Paterson, N. J., died at his cottage at Cape May, N. J., a few days ago at the age of forty-one years. The cause of death was hemorrhage of the stomach, after an illness of one day. He was largely interested in the Sauquoit Silk Manufacturing Company, of Philadelphia, and was besides an importer and manufacturer of raw silks.

Trade and Industrial Notes.

THE WESTERN ELECTRIC COMPANY, which carries a complete line of iron armored conduit, has recently increased its stock of fittings for conduit.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Chicago, states that the demand is steadily increasing for the divided circuit toll line system. The system is said to be better than the bridging system, and in no way infringes the Carty patent.

AFTER CHEAP LAMPS.—Messrs. Walker & Kepler, 521 Chestnut Street, Philadelphia, have been deluged with letters containing 8 cents for a sample of their lamps. They have no 8-cent lamps. Through a typographical error in a recent number of this journal the price per sample lamp was made to read 8 cents instead of 18 cents. Hence the rush for the cheap lamps.

CONTINUED DEMAND FOR FAN MOTORS.—Although summer is at an end the Western Electric Company reports that the demand for its fan motors continues. The public has become educated to the advantages of good ventilation, and the fan motor has been found to be one of the best means of preventing stagnation of air. It is also useful for drying purposes in photograph galleries, engraving establishments and laundries.

MESSRS. EUGENE MUNSELL & CO., of New York and Chicago, importers and wholesale dealers in mica, report a very gratifying demand for their India mica. They carry a large stock at both their warehouses in New York and Chicago, and are, therefore, in a position to execute orders promptly. This concern was one of the pioneers in the preparation of mica for electrical purposes, having sold to the Edison Company at a time when the latter concern employed but two armature winders. This was in the eighties.

THE ELECTRIC APPLIANCE COMPANY, Chicago, has taken the general Western agency of the Utility Shade Company, manufacturer of the Utility shade in paper and celluloid. These shades are something new in the electrical line, and are destined to find a very large field, as they possess a great many points of merit, among which may be mentioned the following: They are very light in weight, neat in appearance and practically indestructible. They require no separate shade holder and are low in price. They are made in a number of different shades and colors. The Electric Appliance Company has issued a special catalogue of these goods, a copy of which it will be pleased to send to the trade upon application.

THE CARBORUNDUM COMPANY, of Niagara Falls, N. Y., has just issued a most interesting and instructive illustrated catalogue of its carborundum specialties, which also contains a very complete description of the manufacture and development of carborundum at the company's Niagara Falls works. The carborundum wheels for grinding and polishing purposes manufactured by this company have distinct characteristics of their own, which are of the greatest value to manufacturers and machine shop men who require a perfect wheel combining other qualities than those possessed by the regular emery wheel. Everyone interested should have one of these catalogues, a copy of which will be furnished upon application to the Carborundum Company, Niagara Falls, N. Y.

STREET RAILWAY DIRECTORY.—The first number of the American Street Railway Directory has just been issued by Mr. E. L. Powers, publisher, New York and Chicago. The directory is new only as a separate and independent publication, the subject matter having appeared before as part of the "Standard Electrical Directory," which covered the lighting and railway fields in one. In its new form it is corrected up to date and is authentic. It will be

published quarterly with corrections. A very carefully collated and compiled table of street railway statistics gives the track mileage, capitalization and car equipment of street railways in the United States by States. This table, the publisher states, can be depended upon for accuracy.

THE WESTERN TELEPHONE CONSTRUCTION COMPANY, Chicago, has just issued a very neat and carefully gotten up catalogue of its various manufactures, including switchboards and telephone equipment for independent telephone companies. The catalogue contains 136 pages, and after a little address to the independent telephone companies it describes and illustrates the switchboards and exchange equipment manufactured by the company. The various styles of switchboards covered in the descriptive matter include the Western express board, equipped with combined self-contained removable spring jacks, drop and coils, and a like board for multiple transfer systems. A combined telephone and switchboard is also shown and described. The catalogue is very complete, and will be of great interest to all connected with the telephone service.

THE RASTER CARBON RHEOSTAT COMPANY recently moved into new quarters at 231 South Canal Street, Chicago, where it has a fine office and complete factory appointments, which facilities permit of the company's handling an increased business. The carbon rheostat business has rapidly developed in the last few months, and the company reports that it is highly pleased with the appreciation shown by the trade in its product. Some flattering reports are being received, and some yearly contracts have lately been closed. All of the company's devices are covered by patents which it claims to control or to which it has a legal right. The company is manufacturing a full line of automatic motor starting and regulating rheostats, as well as all kinds of theatre dimmers, field regulators and elevator controllers. Since the close of the war its business has shown a marked increase. It has established offices in St. Louis, New York and Milwaukee, and has lately made foreign shipments. Carbon rheostats, as made by this company, are said to be satisfactory mechanically and electrically, and the company reports that the underwriters have lately rendered the same decision, which further substantiates the claims of the company.

Directory of Scientific Societies, Associations, Etc., an Meetings of the Same.

THE NEW YORK ELECTRICAL SOCIETY.—President, Gano S. Dunn; secretary, George H. Guy, 120 Liberty Street, New York.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA, Pittsburg, Pa.—Meetings, third Tuesday of each month.

CANADIAN ELECTRICAL ASSOCIATION.—President, William H. Browne, Montreal; secretary, C. H. Mortimer, Toronto, Ont.

HENRY ELECTRICAL SOCIETY meets every other Friday evening between October and May. Headquarters, 115 West Twenty-eighth Street, New York City.

CHICAGO ELECTRICAL ASSOCIATION.—Meetings, first and third Friday of each month, from October 1 to June 1; J. R. Cravath, secretary, Monadnock Block, Chicago, Ill.

NORTHWESTERN ELECTRICAL ASSOCIATION.—President, F. A. Copeland, La Crosse, Wis.; secretary, Thomas R. Mercein, Milwaukee, Wis.

MASSACHUSETTS CHARITABLE MECHANIC ASSOCIATION, Boston, Mass.—Exhibition of Motor Carriages, October 10 to December 3, 1898.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK.—President, G. Tracy Rogers, Binghamton, N. Y. Secretary, Henry A. Robinson, New York City. Next meeting, Ithaca, N. Y., September 12 and 13, 1899.

NATIONAL ELECTRIC LIGHT ASSOCIATION.—President, A. M. Young, Waterbury, Conn.; secretary, George F. Porter, 203 Broadway, New York. Next meeting, New York, May or June, 1899.

AMERICAN STREET RAILWAY ASSOCIATION.—President, C. E. Sergeant, Boston, Mass.; secretary, T. C. Penington, 2020 State Street, Chicago, Ill. Next meeting, Chicago, 1899.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS.—President, W. W. Ryder, Chicago; secretary, P. W. Drew, Milwaukee, Wis. Next meeting, Wilmington, N. C., June 19, 1899.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, New York.—President, Dr. A. E. Kennelly; secretary, Ralph W. Pope, 26 Cortlandt Street, New York. Meeting, fourth Wednesday of each month, from September 1 to June 1. Next meeting, September 28: Paper, "Photometry of the Enclosed Alternating Arc," by Charles P. Matthews.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES.—President, R. R. Bowker, New York; secretary, Wilson S. Howell, P. O. Box, 114, Newark, N. J. Next meeting, 1899.

THE PACIFIC COAST ELECTRIC TRANSMISSION ASSOCIATION. President, W. F. Pierce; secretary, George P. Low, 427 Tenth Avenue, San Francisco, Cal.

THE OHIO ELECTRIC LIGHT ASSOCIATION.—President, Emil C. Schmidt, Sandusky; secretary and treasurer, Samuel Scovil, care of Cleveland Illuminating Company, Cleveland. Next meeting place, Cleveland, 1899.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION.—Dr. C. R. Dickson, Toronto, Can., president; Dr. John Gerin, Auburn, N. Y., secretary.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION.—President, Robert E. Wright, Allentown; secretary, S. P. Light, Lebanon. Last meeting, Scranton, Pa., September 7-8, 1898.

ASSOCIATION OF FIRE AND POLICE TELEGRAPH SUPERINTENDENTS AND MUNICIPAL ELECTRICIANS.—President, J. W. Aydon, Wilmington, Del.; secretary, H. T. Blackwell, Jr., New York. Next meeting, Wilmington, Del.

THE SOUTHWESTERN GAS, ELECTRIC AND STREET RAILWAY ASSOCIATION.—President, Carl F. Drake, Austin, Tex; secretary, E. L. Wells, Jr., Marshall, Tex. Next meeting, Austin, Tex., April 19, 1899.

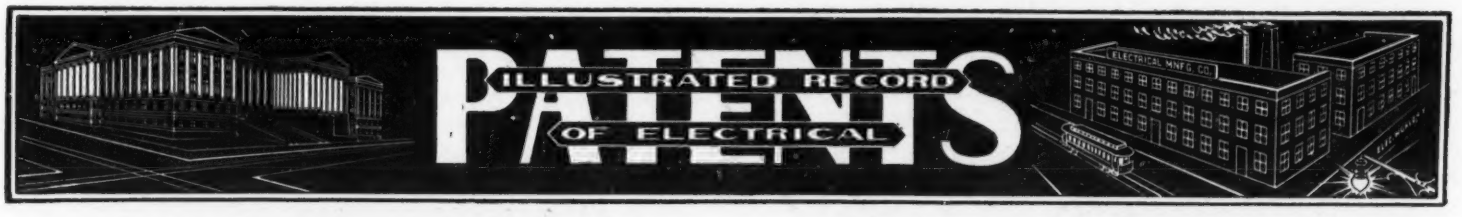
INDEPENDENT TELEPHONE ASSOCIATION OF THE UNITED STATES.—President, Judge James M. Thomas, Chillicothe, Ohio; secretary, W. J. Vesey, Fort Wayne, Ind. Next meeting, June, 1899. Place to be named hereafter.

FRANKLIN INSTITUTE (Electrical Section), Philadelphia, Pa.—Secretary, William H. Wahl. Next meeting September 27. Papers to be read: "Rail Bonding, with Especial Reference to Cast Weld Joints," by W. E. Harrington; "The Present Status of the Storage Battery," by Herbert W. Lloyd.

THE BROOKLYN INSTITUTE OF ARTS AND SCIENCES, Brooklyn, N. Y. Henry T. Weed, secretary. Meetings: October 7, lecture by A. L. Riker on "Electric Carriages," illustrated by lantern photographs; November 4, illustrated lecture by T. C. Martin; December 2, lecture by Prof. William E. Geyer, Stevens Institute; January 6, lecture on "The Electro-Metallurgy of Copper," by John B. F. Hereschoff; February 3, lecture and experimental demonstrations by Prof. M. I. Pupin; March 3, illustrated lecture on "Electricity in the Navy," by Captain Zalinski, U. S. N.; April 7, lecture on "Cable Telegraphy," by A. E. Kennelly; May 5, lecture by Prof. William A. Anthony.

Business Notice.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 9-15 Murray Street, New York City.



UNITED STATES PATENTS ISSUED SEPTEMBER 20, 1898.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

610,887. AUTOMATIC CIRCUIT BREAKING SWITCH; W. F. Bossert and William D. Pomeroy, of Utica, N. Y. App. filed July 12, 1897. In an automatic circuit breaking switch, an electrical catch for securing the switch in open position, the said catch being operated by a normally open subcircuit closed by the switch in open position with reference to the main circuit.

610,895. CONTROLLER FOR ELECTRIC MOTORS; F. E. Case, of Schenectady, N. Y. App. filed April 2, 1898. In a controller for electric motors operated in pairs in series and parallel, three-blade cut-out switches for each motor, two of the blades of which shift the motor connections, and the third blade of which opens a connection common to all the switches.

610,898. ELECTRIC ARC LAMP; M. Harris, of New York, N. Y. App. filed Oct. 27, 1897. In an arc lamp, the combination of a fixed outer globe provided with an opening in its bottom, a cover removably attached to said opening, a movable inner or arc enclosing globe and a support for the same wholly enclosed within the outer globe, means for lowering the inner globe with its support through the opening in the outer globe, and means for sustaining it in its lowered position, substantially as described.

610,899. ELECTRIC METER; C. D. Haskins, of Newton, Mass. App. filed June 24, 1898. The method of calibrating an electric meter, which consists in changing the current flow in the starting coil to compensate for local errors without changing the current flow in the armature circuit.

610,903. CIRCUIT BREAKER FOR THREE-WIRE SYSTEMS; E. M. Hewlett, of Schenectady, N. Y. App. filed Sept. 7, 1897. The combination with a series coil carrying the main current and the trip of a circuit breaker, of a shunt coil acting to open the circuit and controlled by exterior contacts.

610,904. SAFETY DEVICE FOR DYNAMO ELECTRIC MACHINES; E. M. Hewlett, of Schenectady, N. Y. App. filed April 4, 1898. The combination with an electric generator, a steam engine driving the generator, a governor for the engine, and means controlled by the governor for interrupting the circuit of the generator when the engine tends to race.

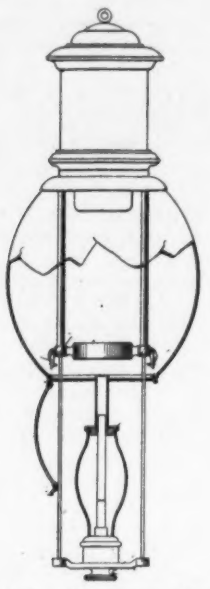
610,908. ELECTRIC BRAKE; John B. Linn, Schenectady, N. Y., assignor to the General Electric Company, New York. App. filed Jan. 7, 1898. In an electric braking apparatus, the combination, with a number of dynamo electric armatures and brake mechanisms upon common axles, of means for passing the current from one armature through the field of another of the dynamo electric machines.

610,909. RAIL BOND; J. E. Lloyd, of New York, N. Y. App. filed Nov. 12, 1896. In a rail bond, the combination with the rail and wire, of a washer adapted to be inserted in the rail and provided with a tapered passage having a plurality of tapers, said wire having a tapered or enlarged end to fit said passage, substantially as described.

610,927. TROLLEY; O. W. Swanson, of Tacoma, Wash. App. filed Sept. 18, 1897. A centre member provided with opposite hubs, squared at the outer extremities, and provided with an annular recess between said member and extremity.

610,928. ELECTROSTATIC MEASURING INSTRUMENT; E. Thomson, of Swampscott, Mass. App. filed March 27, 1897. In a measuring and indicating instrument, the combination of a vibrating needle and stationary indicators separated from each other by an insulating medium, with a shield enclosing the moving parts of the instrument.

610,999. ELECTRIC HEATER; J. F. McElroy, of Albany, N. Y. App. filed March 18, 1895. An electric heater, consisting of a casing provided with a

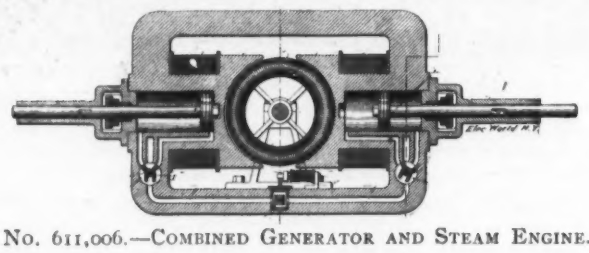


No. 610,898.—Electric Arc Lamp.

metal front piece, the upper portion of which is perforated and projects through a perforation in the riser of the car seat, a rabbeted portion extending behind and below said riser, a suitable support with openings therein to permit air to enter from below, a non-conductive lining at the back and top of said casing, a resistance placed therein, a car body provided with a seat, a riser placed beneath said seat and entirely closed except where said perforated plate is inserted, said seat arranged to provide for an air passage between the back of the seat and the outer wall of the car, substantially as described.

611,000. ELECTRIC COUPLING; J. F. McElroy, of Albany, N. Y. App. filed Jan. 9, 1896. In an electric coupler, a block provided with two openings, a metallic plate secured within each of said openings, a metallic finger secured to each of said plates, a means for connecting said plates with a stationary core, a connecting cable provided with a handle containing a metallic cylinder adapted to fit upon said finger, substantially as described.

611,001. ELECTRIC HEATING SYSTEM; J. F. McElroy, of Albany, N. Y. App. filed July 6, 1896. A switch composed of a spindle, metallic contacts thereon, brushes adapted to rest on said metallic plates, a notched plate secured to one end of the switch, one surface of said plate irregular in form and indented at intervals, a plate mounted on said spindle, to which is hinged a latch adapted to engage in the indentations on said notched plate, a post projecting from said plate carrying said hinge, an auxiliary spindle,



No. 611,006.—Combined Generator and Steam Engine.

a cam plate secured to said auxiliary spindle, the inclined surfaces of said cam plate approaching each other at their lowest point and gradually rising to the right and left respectively, said cam plate carrying a post, a collar mounted on said auxiliary spindle, a spring on said auxiliary spindle, one end of which is secured to said collar, a lug on said collar adapted to engage with said posts, a thimble mounted on said auxiliary spindle, a lug attached to said thimble, adapted to engage with the opposite sides of said post from which the lug on the collar engages, one end of said spring attached to said thimble, substantially as described.

611,006. COMBINED GENERATOR AND STEAM ENGINE; M. L. Whitfield, of Memphis, Tenn. App. filed Nov. 16, 1897. A field magnet or pole piece having its interior hollowed so as to constitute a piston chamber, and having valve passage formed within said field magnet or pole piece, in combination with a piston and suitable valve mechanism, substantially as described.

611,012. ELECTRIC BATTERY; V. Jeanty, of Paris, France. App. filed Oct. 21, 1897. An electric battery, comprising a receiver, an electrode in said receiver, a non-conducting and impervious trough located in the receiver, said trough being closed at the bottom and open at its upper portion, and another electrode in the trough, the upper edge portion of the trough being at approximately the same level with the upper edge of the electrode in the receiver.

611,056. ELECTRIC RAILWAY CONSTRUCTION; W. Chapman and P. W. Davies, of Pittsburg, Pa. App. filed Nov. 23, 1897. A contact rail for electric railways of inverted-trough shape, in combination with a clamp having jaws for gripping the rail edges, a block provided with a socket for the supply conductor, a plastic bond between the block and the rail and a wedge between the block and the clamp.

611,087. CONTACT FINGER FOR CONTROLLERS OR ELECTRIC SWITCHES; T. V. Zweigbergk, of Cleveland, Ohio. App. filed Feb. 23, 1898. In a contact finger, the combination of a frame, a spring arm carried thereby, a contact knob carried by the spring arm and adapted to normally stand in position to be engaged by a controller segment, and a hook pivoted to the frame and adapted to hook the knob back out of the path of the controller segment, substantially as described.

611,088. GOVERNING, REVERSING AND BRAKING CONTROLLER; T. V. Zweigbergk, of Cleveland, Ohio. App. filed Feb. 23, 1898. The combination with an electric brake and a controller adapted to apply the brake, of an automatic switch inserted in the circuit to the electric brake, and adapted to increase the resistance to the current in that circuit as the strength of the current increases, substantially as described.

611,089. METHOD AND MEANS FOR CONTROLLING AND CUTTING OUT ELECTRIC MOTORS; T. V. Zweigbergk, of Cleveland, Ohio. App. filed April 29, 1898. The combination with a controller having a series of contact plates and fingers and a motor suitably connected with the fingers, of mechanism adapted to hold a certain contact finger out of the path of the plate, and thus cut out the motor, substantially as described.

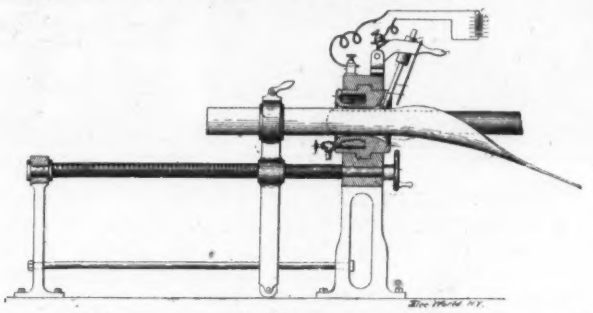
611,090. CONTROLLER; T. V. Zweigbergk, of Cleveland, Ohio. App. filed April 29, 1898. In a controller, in combination, a reversing cylinder, a reversing lever, a shaft for the latter independent of the reversing cylinder, a locking device adapted to lock said shaft to the reversing cylinder or to release the reversing cylinder and lock said shaft to a stationary member, substantially as described.

611,151. SYSTEM OF ELECTRICAL DISTRIBUTION; C. F. Scott, of Pittsburg, Pa. App. filed Oct. 22, 1897. A system of distribution for alternating currents, comprising two circuits carrying currents differing in phase and each embodying two main conductors and a neutral or balancing conductor, adapted to supply translating devices in multiple series, a fourth conductor for one of said circuits connected at one end to one of the main conductors of the other circuit, and a connection between the other main conductor of the last-named circuit and the balancing conductor of the four-wire circuit.

611,162. ELECTRIC ARC LAMP; E. S. Worsley, of London, England. App. filed March 15, 1898. An electric arc lamp provided with short circuiting devices, comprising in combination with the main coil of the lamp and its core, a piece or block of magnetizable material with which said core is adapted to come into contact and short circuit the carbons when their proper feeding is interrupted, and a spring adapted to tend to keep the core and block apart, substantially as described.

611,185. RHEOSTAT; C. H. Richardson and L. McMakin, Jr., of Philadelphia, Pa. App. filed Feb. 3, 1898. The combination, in a rheostat, of the case, the resistance track, the movable contact arm, the handle for turning said contact arm, provided with a dial plate, and the index supported in fixed relation to the rheostat case, substantially as described.

611,206. CIRCUIT INTERRUPTING DEVICE; D. M. Moore, of Newark, N. J. App. filed July 3, 1897. A break wheel of metal filled in between the contact surfaces with vitreous insulating material.



No. 611,222.—Method of and Means for Manufacturing Metal Tubing.

611,215. ELECTRIC CONTROLLER; S. Harris, of Twinsburg, Ohio. App. filed May 2, 1898. The combination in an electric controller of a pair of concentric shafts, a pair of switch cylinders carried thereby, two sets of fixed fingers engaging therewith, and a single mechanism arranged to actuate either of said shafts.

611,222. METHOD OF AND MEANS FOR MANUFACTURING METAL TUBING; E. E. Ries, of New York, N. Y. App. filed Jan. 18, 1896. The method of manufacturing tubes from webs of metal, which consists in progressively folding the web into a tube, with the meeting edges in abutment and sprung together by the resiliency of the metal of the web, progressively heating the contacting edges to a welding temperature, whereby said edges are upset and welded by the spring of the tube, and redrawing the said welded tube for finishing, substantially as described.